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MAY, 1897. VOL. IX. NO. 5.

The Geographical Journal

INCLUDING THE PROCEEDINGS OF THE ROYAL GEOGRAPHICAL SOCIETY.

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For Notices as to the Society's Meetings and other important matters, see p. iv.

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The Geographical Journal.

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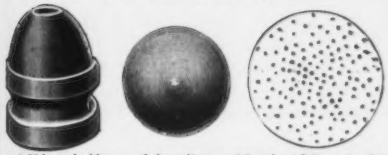

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Evening Meetings.—Papers to be read at the Evening Meetings in May:—**Monday, May 10.** Recent Journeys in Sze-Chuan, Western China. By Mrs. Bishop. **Monday, May 31.** The Country of Nupe in Nigerland. By Lieut. Seymour Vandeleur, D.S.O.

Afternoon Meeting.—**Wednesday, May 12,** at 4.30 p.m., in the Map Room. Variation and Dip of the Magnetic Needle. By Arthur W. Horsburgh.

Anniversary Meeting, Annual Dinner and Conversazione.—The Anniversary Meeting will be held in the Theatre of the University of London, on Monday, May 17, at 2.30 p.m. The Annual Dinner of the Society will take place on the same evening, in the Whitehall Rooms of the Hôtel Metropole, at 7.30 p.m. A Conversazione will be held on June 10, at 9 p.m., in the Natural History Museum, South Kensington; details will be sent to Fellows by Circular. It is requested that Fellows intending to be present at the Dinner will send intimation to the Chief Clerk as soon as possible.

Educational Lectures.—Under the joint auspices of the Society and the London University Extension, Mr. H. J. Mackinder, M.A., is giving a course of twenty-five lectures on the Geography of Europe, Asia, and Northern Africa, at Gresham College, Basinghall Street, E.C., on successive Mondays at 6 p.m. To these lectures Fellows are admitted free on showing their tickets. For details apply to the Secretary, London University Extension, Charterhouse, E.C.

Any Fellow resident in this country, desiring to have notice of the subjects of papers to be read at the Society's Meetings forwarded to him, can receive such notices by post on payment in advance to the Chief Clerk, at 1, Savile Row, of 2*s.* per session.

The Society's House will remain open for the Convenience of Fellows on the evenings of the Society's ordinary meetings till 8.15.

The
Geographical Journal.

No. 5. MAY, 1897. Vol. IX.

SOME RESULTS OF THE NORWEGIAN ARCTIC EXPEDITION, 1893–96.*

By FRIDTJOF NANSEN, D.Sc., D.C.L., LL.D.

It might seem desirable to lay before the readers of this Journal a full survey of the additions to our knowledge of the northern regions and their physical conditions acquired during the three years we spent there. But the material we brought home is so abundant, that a long time must elapse before it can be put into shape by the various specialists. It is obvious, then, that only after such preparation will it be possible to give any complete account of the results themselves and of their scope. An attempt to give some of these results now would undoubtedly be to run the risk of making many errors, of giving a false impression of what the expedition has contributed to science, and, in addition, the survey itself would be very imperfect. But the Royal Geographical Society may rightly expect to hear something of the results, and so I shall give what I can, though on the express understanding that this is only a provisional account, which has no pretension to be other than a vague outline of a few of the results and investigations which, at the moment, seem to be of importance. I will begin with that branch of science with which this Society is particularly concerned—geography.

When due regard is had to the manner in which this expedition was planned and carried out, it is not in the nature of things to expect that any great geographical discovery, as the term is popularly understood, would be the result. Our expedition was intended to be a sea-expedition pure and simple, which was to drift with the drift-ice and,

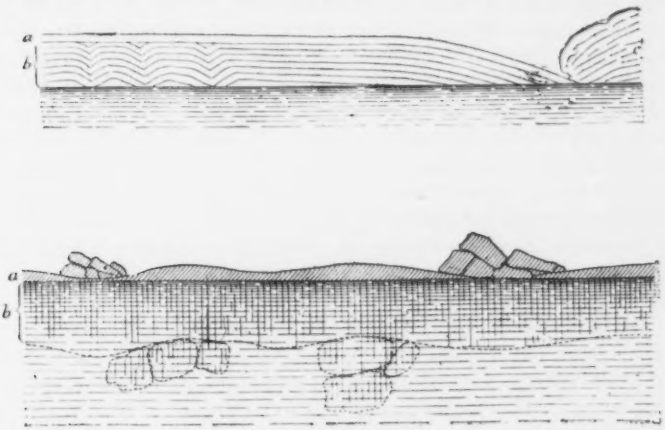
* Map, p. 588. For the illustrations which accompany this paper we are indebted to Messrs. Constable & Co., the publishers of Dr. Nansen's 'Farthest North.' The route-map, with certain modifications, has also been reproduced from the same work.

by preference, keep clear of all land. The discovery of new lands can therefore hardly be said to have been our object, and we were fortunate enough, I had almost said, not to discover any. I say fortunate, for the reason that such new lands might easily have prevented the successful issue of the expedition, as they would have stopped the drift of the ice. But negative results are also an outcome, and I think I may say that the expedition has contributed not a little to the increase of our knowledge of the distribution of land and sea in the regions nearest the north pole.

Before entering upon further reference to this, I will, however, first dwell shortly on some small changes in the configuration of the coasts along which we travelled. The first and foremost of these was the coast of Asia, where we made some discoveries of minor importance. In the Kara sea we discovered an island which, after its discoverer, was called Sverdrup's island. Along the coast of Asia we discovered several new islands and groups of islands. We landed on Kjelman's islands, discovered by Nordenskjöld, and made various observations of interest regarding their appearance and extent. North-east of these we found a group of islands we called Scott Hansen's islands; north-east of these, again, lie Clements Markham's islands; north of them are the Ringnaes islands; north-east are Mohn's islands; and east of some others, and nearer the coast, lie General von Tillo's islands. When we arrived at Taimyr island, which was visited by Nordenskjöld, we made a discovery of greater importance. We found that our way was barred by land-fast unbroken ice. As will be remembered, there are, according to Nordenskjöld's chart, on the north side of this island, due north of Cape Laptev, three or four islands only, and these he called Almquist's islands. We thought, therefore, that it must be an easy matter to find a way outside them; but, to our astonishment, we continually found new islands stretching further and further north, and when we at last reached the northern extremity of these, there was still no passage; the ice lay close in to the coasts. They appeared to be an extensive group of islands, and for a long time I was in doubt as to whether what we had on our east were a large continuous land or several islands of lesser extent, as wherever I turned the glass inwards I saw land. The weather, however was so thick that one could not see far, and I am inclined to think that they are a large group of islands lying at the northern end of Taimyr island.

I have called them after the man who showed us the way along the coast of Asia, the discoverer of the north-west passage; they bear the name of Nordenskjöld's islands. I am, however, inclined to believe that this group of islands had already been discovered, and that by the Russian Laptev, who travelled along the coast in sledges, but by whom they were taken for a continuous island, and that in reality they are the same as those marked on the older Russian charts as Taimyr island, which is separated from the mainland by a broad sound. The latitude

also seems to coincide with this, although the most northern islands in our group are situated a good way north of the Taimyr island of the Russian chart. I think, then, that the Taimyr island found by Nordenskjöld was in reality taken by Laptev to be the mainland, and that the Taimyr sound found by him is, in point of fact, a new discovery. It seems very reasonable to suppose that a sound as narrow and crooked as this one, which one cannot see right through, would not have been discovered by persons passing quickly by, especially when travelling in sledges. When we were there, I could not myself, even from the crow's-nest on the main mast of the *Fram*, clearly discern what it was, as it looked like a small closed-in fjord. It seems inconceivable to me



ICE STRATIFICATION.

that any one, even had he really discovered the sound, could have marked it on the chart as the broad strait we find between Taimyr Island and the mainland on the Russian charts.

After being stopped at the north end of this group of islands, we were constrained to turn back again and make an attempt further south. We hoped for Nordenskjöld's Taimyr sound. There, however, progress seemed somewhat difficult, and we lay to for several days to investigate the sound further before daring to penetrate into it with the *Fram*. There too we made several discoveries, finding the land indented by fjords and sounds, and with many islands outside. At last on September 6 a gale broke up the ice, and we were able to get past Cape Laptev and into Taimyr bay. Great, however, was our astonishment to meet here, halfway in the bay according to the old charts, low sandy land stretching out like a broad tongue into the Taimyr sea. I called this tongue of land King Oscar's peninsula. In what manner it trends southwards we naturally could not determine for

more than a very short distance, and I have therefore tried to unite it as well as I could with what the earlier charts indicate as the coast about the mouth of the Taimyr river farther south, and which one may suppose to be fairly correctly placed.

On the east side of this tongue of land, as will be seen by the charts, a shallow bay runs into the land, which we called Toll's bay. A little further north we found a deep fjord, which penetrated inland as far as I could see, and which was probably the mouth of a good-sized river. The coast of the whole of the Chelyuskin peninsula northwards is very low, while inland we observed somewhat high mountain ridges, partly covered with snow, and on some I should almost be inclined to think there were small glaciers. Near Cape Chelyuskin itself there was a table-mountain (Mount Eivind Astrup) of medium height, which appeared to consist of some kind of sedimentary rock formation. On the west side of Cape Chelyuskin we found two small groups of islands —Fearnley's islands and Axel Heiberg's islands. Farther east there also seemed to be some small changes to be made in the trend of the coast-line. Thus the north-east corner of the Chelyuskin peninsula appeared to stretch somewhat farther north than it is usually marked; while the coast east of Thaddeus inlet, and the islands Peter and Paul, lay somewhat more to the south, as, according to our course, we should have sailed right over them without seeing them. I will not, however, dwell longer on these less important matters.

Without comparison, the most important geographical discovery made during our voyage was that concerning the polar basin itself. This had hitherto generally been considered to be a shallow sea,* in any part of which it might be expected to find land. This was pointed out at the meeting of the Royal Geographical Society during the discussion that took place before my departure. The reason of this assumption was the fact that, so far as the sea had been examined hitherto, it was everywhere shallow. In the sea south of Franz Josef Land and Spitsbergen, there was a depth of as much as 160 fathoms, while along the coast of Siberia not more than 40, at most 80, fathoms had been found. Then the expeditions which had penetrated northwards into this sea had always discovered new land. Thus the Austro-Hungarian *Tegethoff* expedition discovered Franz Josef Land during its drift, and the *Jeannette* expedition discovered Henrietta island, Jeannette island, and Benett island. In the plan of this expedition, I urged the possibility that a deeper channel might run across the unknown polar basin, uniting the Atlantic Ocean with the tract where the *Jeannette* had drifted; I drew attention to the fact that the sea stretching

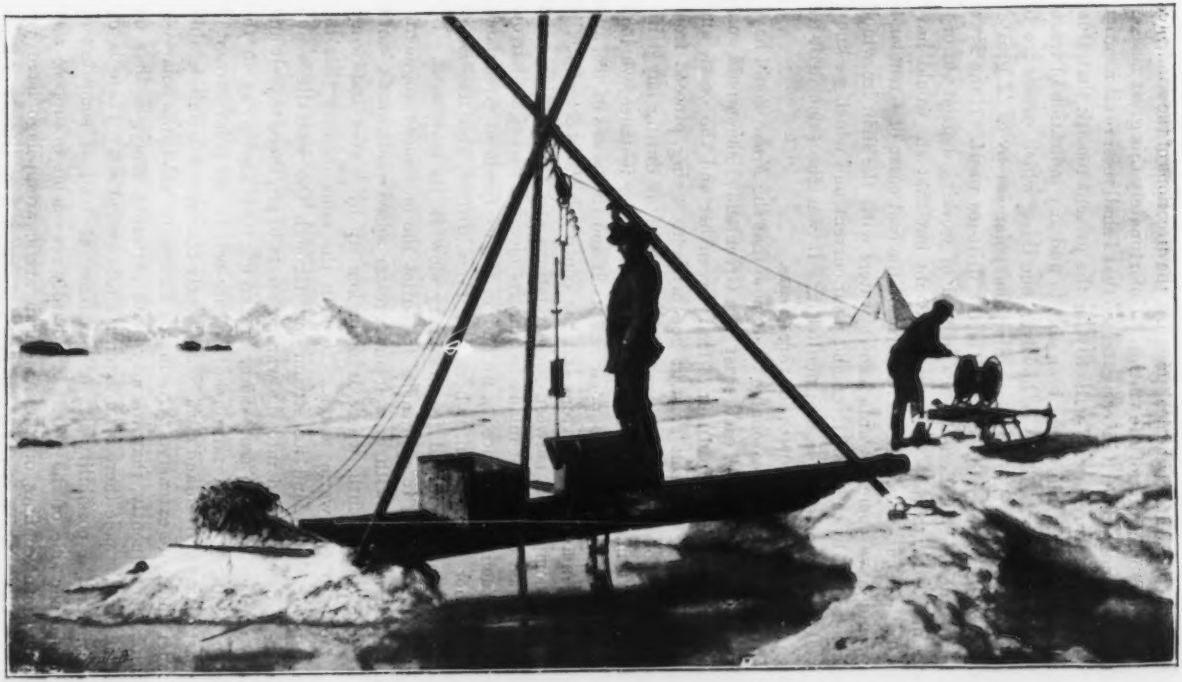
* Not all authorities were of this opinion, however; twenty years ago had Sir Clements Markham maintained that there was deeper water to the north of Franz Josef Land, as will be mentioned later.

TAKING A SOUNDING OF 2058 FATHOMS.

northwards between Spitsbergen and Greenland was very deep—up to 2600 fathoms; and, at the same time, that the *Jeannette* seems to have found an increase in the depth northwards, or possibly only a narrow channel of water 80 fathoms deep, while on either side there were only 40 fathoms or less: and I then thought that these facts might possibly be connected with each other. I had, however, imagined the polar basin, taken as a whole, to be shallow. We found great depths, the sea in lat. 79° N., north of the New Siberian islands, suddenly becoming deeper and sinking to a depth of 1800 to 2000 fathoms, and this depth was preserved during the entire drift of the *Fram* north-west and west, as far as north of Spitsbergen. It is my opinion, thus, that not only does such a channel exist, as I had surmised, but that we must take it for granted that the polar basin, considered as a whole, is a deep sea which forms a continuation northwards and eastwards of the same depth as the northern part of the Atlantic Ocean. How far this deep sea extends to the east it is difficult to form any opinion; we know now that it goes as far as to the north of the New Siberian islands, but it is only reasonable to suppose that it extends still further east, since, in the case of the *Jeannette*, every time the drift set her northward or north-eastward, the depth of the sea was found to increase.

What, then, is it reasonable to suppose with regard to the distribution of land and sea in the yet unknown polar area? I think we may with safety say that little or no land can lie on this side of the pole, as it is not probable that such a deep sea should only be a narrow channel. It appears to me to be too continuous for this, and on this account alone I should be inclined to think that it extends a good way north of that part of the sea traversed by us. In addition to this, we saw no indication whatever of land in any direction. During our sledge-journey north of the *Fram's* route, the ice appeared to be drifting with great speed—even greater than that of the ice we found further south. There was a great deal of movement in the lanes, and at different times we were carried away in different directions with some rapidity—so rapidly, in fact, that it sometimes seemed as if we had been given up, helpless, to the violence of the wind and current. Masses of ice like these could hardly move with such great freedom in different directions if land of any extent were in the vicinity, as this would cause insurmountable obstacles to the drift. It ought also to be remembered that this was particularly the case every time the wind carried us in a northerly or north-westerly direction, but that, on the other hand, the drift seemed to be unusually sluggish every time we were set back towards the south-east.

A good indication as to how far tracts of land of any extent are to be assumed farther north or not, we shall certainly find in our meteorological observations; the course of the isotherms and the



DEEP-WATER TEMPERATURE. "UP WITH THE THERMOMETER."

distribution of the atmospherical pressure, the directions of the wind, etc., must tell us something of the matter. Unfortunately this great mass of material has not yet been investigated, so that I shall reserve all mention of it till some future date. I will only for the present remark that, from these data, hitherto I have not been able to find any indication of tracts of land north of us. There is, however, one thing which causes me to think that we are right in supposing the polar sea to be of greater extent north of our route, and that is the drift-ice itself. If the *Fram* had continued her drift in the ice instead of working herself out of it north of 83° N., there is no room for doubt but that she would have been drifted southwards in the vicinity of the east coast of Greenland. She would have come towards known waters with the drift-ice which is carried down by the east Greenland polar current, and which we know so well from Scoresby's description of it. It was the same drift-ice which we had struggled with for three years.

It is not, however, reasonable to suppose that the *Fram* would have drifted close under the east coast of Greenland; she would undoubtedly have had a broad belt of ice between her and the coast, and the ice composing this belt must, it goes without saying, proceed from a part of the polar sea which lay to the north of us during our drift, and this part may be of fairly great extent. If, for instance, we look at the relation between the polar sea itself and its masses of ice, and the east Greenland polar current and the continual transport of ice, it suggests a comparison between these relations and those which exist between a vast expanse of inland ice and its ejection through a narrow ice-valley, such, for instance, as we find in the ice-fjords of Greenland. In the inner polar basin, where the *Fram* drifted, the ice, as in the interior of the inland ice, was very slow in its movement. By degrees, however, as it approaches its outlet the movement augments, the ice streams off with greater and greater speed southwards, until it at last comes south, where it is broken up by waves and wind, and melts in the warm water. It is in the same manner that the offshoots of the inland ice stream out through the ice-valleys and the ice-fjords and down into the warmer strata of air, there to melt and finally emerge into the sea, where, broken off, they float away in the form of icebergs. A certain breadth of ice-belt in the polar current of the east coast of Greenland must consequently correspond to considerably broader and more extensive parts in the known or unknown polar sea. I think, consequently, that we may with certainty conclude that on this side of the pole there is an extensive ice-covered sea. There is, on the contrary, a possibility of the existence of land of some extent on the other side of the pole. It is hardly reasonable to suppose that the northern confines of the American arctic archipelago have yet been reached. We may expect to find islands, perhaps islands of some magnitude, north of the limit which has been reached. A closer

examination of these parts, we must hope, will be undertaken in a not distant future.

Before I conclude this short summary of the geographical results of the expedition, I must touch on a point which may be of some importance, and this is the character and extent of Franz Josef Land. The drift of the *Fram* has, as before mentioned, revealed to the north of Franz Josef Land a deep sea, and that this land can have no such extension northwards as has been surmised in several quarters. The discoveries made during Johansen's and my sledge-journey over the ice serve only the more to corroborate this statement. The discoveries we made here may not seem overwhelming to some people; for already twenty years ago the President of this Society, Clements Markham, said, "Franz Josef Land seems to be a part of the Spitsbergen group, rising out of the same shallow sea, with deeper water to the north."

This expression of opinion was then a somewhat isolated instance, and aroused contradiction rather than the reverse, at a time when it was customary to consider Franz Josef Land as the south coast of an extensive mass of land. I can now, after having myself explored part of this "deeper water to the north," give this opinion my full and entire concurrence. When I addressed this Society before my departure, I expressed it as my opinion that Franz Josef Land was not an eligible point of departure for an expedition to the pole if the object were to press forward overland, seeing that I regarded Franz Josef Land, as I then said, as merely "a group of islands." Our expedition seems also to corroborate this. Franz Josef Land not only proves now to be a group of islands, but a group of comparatively very small islands. How far they extend to the northward we cannot yet determine with precision, but, in any case, their extent in this direction cannot be of importance. Petermann's Land cannot be of any great size, for otherwise we must have seen it when we went southwards in the summer of 1895.

That Oscar's Land, also, is of no great extent I think I may conclude, from the fact that the ice on the north coast outside our winter quarters appeared to drift unhindered from the land towards the north every time a southerly gale sprang up. If there had been land of any extent in that direction—that is to say, where Oscar's Land should lie—it would assuredly have hindered the drift of this ice. Of the extent of the land in an easterly direction, it is difficult at present to form any opinion. When we came west from Hvidten Land—the first islands discovered by us—and perceived the chain of islands west and south of us, they stretched like an apparently continuous coast, here and there only divided by small sounds and fjords. The southernmost land that we saw was Wilczek Land, which, however, seemed to disappear in a south-easterly direction, and we saw no land farther east. On the

other hand, to judge by the sky, there were signs denoting a considerable quantity of open water. That there really are islands in that direction, however, seems possible, from the fact that when we were encamped, during June and July, in about lat. 85° 5′ N. and long. 63° to 64° E., where we lay for a month, waiting for the deep snow to melt in order that our progress southwards might be easier, we had, several times during the month, long periods of strong northerly wind, yet without its being able to drive us farther south, although the ice seemed to move tolerably unhindered in other directions. This might indicate that there was a wall of land to the south of us, running east and west, and stopping the drift of the ice.

I think it is probable that the group of islands composing Franz Josef Land extends very much farther west than we now know, since neither Jackson nor we saw the limits of the land westwards on the north side of Alexandra Land. In point of fact, we discovered new islands in the west as far as our range of vision admitted, and, to judge by the large open land-lane which ran in that direction, one might suppose that the land there was of considerable extent. On the south side of Alexandra Land, Leigh Smith, equally with Jackson, failed to find the western limits of the land. Set this beside the fact of the new land discovered by the Norwegian sealers on the east side of North-East Land, the so-called White island or New Iceland, which is probably the same as the mystical Gillies Land; it is then reasonable to suppose that between these lands there lies a continuous chain of islands, which in reality connect Franz Josef Land with Spitsbergen, and would be so closely continuous, that it would be difficult to say where the one group of islands ends and the other begins. On this point, too, Clements Markham's words, that "Franz Josef Land seems to be a part of the Spitsbergen group," hold good. The geological structure of Franz Josef Land seems also to indicate that this is actually the case, and it is my intention to touch on this directly. In these parts, which Johansen and I should have visited had we not fallen in with Jackson, the Jackson-Harmsworth expedition will no doubt have many interesting discoveries to make.

Before I leave the geography of Franz Josef Land, I have a few words to say relative to the map.

I will first mention a discrepancy between our experiences and Payer's map, a discrepancy which has been the subject of a good deal of discussion, and perhaps also of misunderstanding. It was, however, this discrepancy which brought us to think that the land we met with could not be the Franz Josef Land visited by Payer. It was our opinion, therefore, that our watches must be altogether wrong, and that we had come to a land much further west—either the west coast of Franz Josef Land, or more correctly Alexandra Land, or perhaps Gillies

Land, or some other new land situated between Franz Josef Land and Spitzbergen. Where Payer placed the north end of Dove glacier and

PRESSURE MOUND NEAR THE *FRAM*.

the entire north end of Wilczek Land, we found only sea, with the exception of the four islands which I named Hvidten Land. Of Payer's

Rawlinson's sound we saw nothing, nor the north end of Austria Sound, and his Wilczek Land becomes in reality a smallish island, the northern extremity of which lies about one degree further south than he placed it. I could hardly conceive such a mistake, seeing that the land lay comparatively near his route, and therefore could not for a moment suppose that his map was incorrect, but rather that our watches were wrong. It was only after we had met Jackson and compared our watches, that I discovered that such must nevertheless be the case.

I have thought much as to how this error can have arisen, particularly as Payer's map, on the whole, is so carefully drawn, and, in my opinion, satisfies all the demands which can be made on a map prepared by a man travelling so quickly through a country. Dr. Copeland is now engaged in working on Payer's great materials for a map, and through the kindness of the former I have been enabled to convince myself of the unusual reliability of this important material. I have also seen Payer's sketches, and have been able, through them, to recognize several of the lands seen and visited by us. I think that, by a comparison of Payer's observations with ours, some more exact idea of the northern configuration of this group of islands could be arrived at. When one looks at Payer's sketches and reads his description of his journey northwards towards Crown Prince Rudolf's Land, one receives the impression that it must be easy to make a mistake like that made by him, which was destined to be so fateful for us. It arose from the circumstance that during the greater part of the time he was there he had fog and thick weather, and he says himself that he was under the impression that Wilczek Land ceased a little way north of 81° N., just as it does in reality; but one clear day (April 7) he was, as has been mentioned, disabused of this error, and, as he himself writes, "When the sun scattered the driving mist, we saw the glittering ranges of its enormous glaciers—the Dove glaciers—shining down on us. Towards the north-east we could trace land trending to a cape lying in the grey distance—Cape Buda-Pest, as it was afterwards called. The prospect thus opened to us of a vast glacier-land, conflicted with the general impression we had formed of the resemblance between the newly discovered region and Spitsbergen."

What Payer really saw here were, I think, banks of mist on which the sun was shining, and which on such occasions can have a misleading resemblance to glaciers—a fact which we often had occasion to notice during our journey. These banks of mist extended northwards from Wilczek Land over Hvidten Land, and so onwards towards Prince Rudolf's Land. Perhaps, too, Payer did really see the top of the glacier on the largest of the islands of Hvidten Land—the upper one, which I called Eva island; then, too, he probably saw the nearest of these islands, and has marked it by the name of Freeden Insel.

I can understand all the more easily that such a mistake may arise, since I very nearly was guilty of the same thing myself, seeing that

when I came southwards through the sound discovered by Jackson—the British Channel—along the west coast of Hooker island, I thought all the while that we had a vast continuous glacier-land on our west. It was only when the mist lifted and it cleared on the evening of June 11, that we discovered the broad sound which lies between Northbrook island and Bruce island on one side, and Alexandra Land with Peterhead on the other. Had not this happened, and we had been constrained to make a map of these parts without receiving later information, I should have been guilty of exactly the same mistake as that of Payer farther north, and thus I do not reproach him in any way.

Between our observations and Jackson's map of the land observed by him there are but few discrepancies to be mentioned here. The most important, perhaps, is that the land which Jackson saw to the north, and which he supposed to be King Oscar's Land, is in reality some small islands lying west of our winter hut, some 40′ farther south; we saw them not far from us the whole winter. Jackson, however, expressly states on his map that it was the "approximate position, very misty, distance uncertain, and single bearings;" and when he saw my map he agreed that the land he had seen must be our three islands, for which reason I have not given them any name. The alteration in the position of this land makes it necessary, however, to move Queen Victoria sea, so-called by him, a little further south. This open water, which was fallen in with by him as well as by us, and which we had occasion to see being formed during the course of the winter, cannot, however, be regarded as any open sea; such a designation would easily lead to misconceptions, as this open water must rather be regarded as a land-lead, which, like all other land-leads, is formed and opened by a land-breeze, and is closed again by the wind blowing in shore. This discovery of open water on the north side of the islands one had to be prepared for, as exactly the same thing occurred with Payer twenty-two years ago, as he found a piece farther north on the north side of Karl Alexander Land and the west side of Crown Prince Rudolf's Land.

The other minor discrepancies which Jackson's map shows compared with our observations are of so little moment that I will not even name them. With regard to the giving of names on my map, I will only observe here that when I found out that the land on which we had lived during the winter was divided by a sound from Karl Alexander Land*

* It ought, perhaps, to be mentioned that we did not find the sound which, according to Payer's map, should separate Andrée island from Karl Alexander Land. On discussing this matter with Dr. Copeland, he told me that he could not find anything in Payer's material which indicated the existence of this sound. Payer's original sketch-map had no Andrée island or no such sound, and Copeland believed, therefore, that Andrée island and the sound were due to a mistake by the man who made Payer's map after his return from his journey.

By seeing Payer's sketches of Karl Alexander Land, I have been able to identify various promontories. I could especially easily recognize Cape Felder, which has a

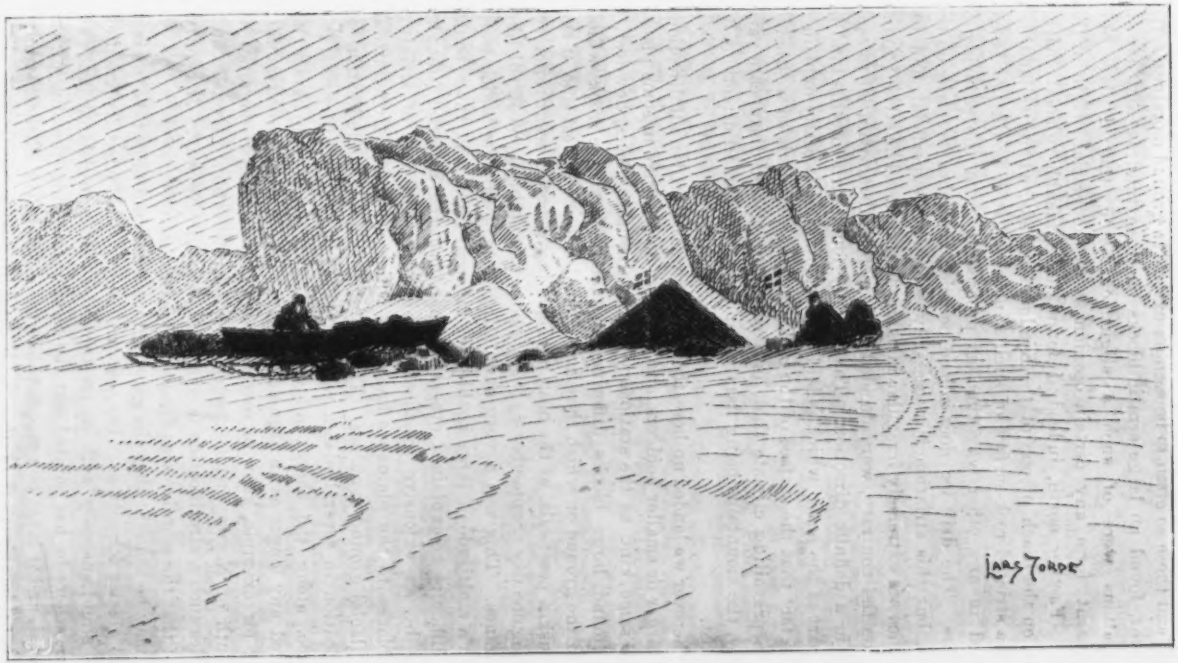
lying north of it, and so named by Payer, I asked Jackson if he had any objection to my calling this land Frederick Jackson's island, as a slight token of our gratitude for his unusual hospitality towards us, and to this he agreed. I have otherwise refrained from giving names to any of the countries which Jackson saw before we did.

The island situated between Jackson's island and Karl Alexander Land I have permitted myself to call after Leigh Smith, as a slight acknowledgment of his important instrumentality in the mapping and investigation of this interesting group of islands. It is, in a measure, a continuation of the work begun by Leigh Smith which the Jackson-Harmsworth expedition has undertaken, and they have already accomplished work deserving of great credit. Jackson's map of the part of the group of islands which he has surveyed gives the idea of great accuracy. Thus, when I compared our observations with his map, I found that for the place where our winter hut was situated, which lies near his northernmost point, there was only a difference of some few minutes. It is particularly unfortunate that, during the last two years, circumstances have prevented Jackson from travelling over a still greater part of this group of islands. In the coming year these difficulties will be surmounted, and we may expect an eminently satisfactory map of the whole extent of this interesting group of islands; one of the more important problems will then be solved yet remaining in the sea on this side of the pole.

In concluding my remarks on the geographical discoveries made by us on our expedition, it may, perhaps, be appropriate to add a few words on the geological character of the countries we visited. The geological investigations we were in a position to make during our voyage along the coast of Asia were necessarily of very small extent, as our visits on shore were of an accidental nature and of extremely short duration. At no place where we landed did we find stationary sediments which were not metamorphosed. As a rule the stationary rocks we met with consisted of crystalline schists and granites; amongst these may be mentioned a characteristic aplitic Muscovite granite from Cape Laptev. On the north-east corner of the Chelyuskin peninsula we observed a very finely grained helleflinta, in its appearance resembling quartzite.

Of more importance were the indications of an ice-period which I thought I found in several places on the north coast of Siberia. The undulating tundra of Yalmal, consisting of sand, clay, and small stones (boulders), had already reminded me of the North German plains, and suggested the idea of a vast ground moraine (till). It was full of

peculiar shape, and which Johansen and I visited on the night between August 16 and 17, 1895 (see 'Farthest North,' vol. ii. pp. 310-312). I describe it in my diary as "a curious high ridge, as sharp as a knife-blade." There is also a photograph from this place in my book, vol. ii., facing p. 730.



OUR NORTHERNMOST CAMP, 86° 13·6′ N. LAT., APRIL 8, 1895.

round depressions and lakes, which reminded one of the North German lakes, and those so often to be seen on extensive ground moraines. We, however, found no large erratic blocks on these tundras, and our investigations were of such a slight character, that I dare not, at present, form any certain opinion as to the glacial origin of this land. Farther north, indeed, I found unmistakable glacial marks. Thus, on the beach of one of the Kjellman islands, where we landed, I found a striated rock-surface of such a nature that it could not be explained in any other way than as proceeding from the scouring of glaciers. The drift-ice does indeed occasion scratches or striæ on the coasts, but this striation is necessarily somewhat superficial, and the scratches are extremely irregular in their direction. The striæ I found here, on the contrary, were decided and deep, and ran parallel to each other in a definite direction. That I only found striæ of this kind in that part of the beach which is laid dry at low tide, is easily explained by the fact that the surface of the rocks in these regions is so weathered by the prevailing climate that, as a rule, all striation disappears very rapidly, the mountains being fissured and shattered in all directions by the frost.

Wherever we landed up here, the country was covered in all directions with larger or smaller boulders, and these, no doubt, were in some places of the same kind as the stationary rocks. In other places, however, I often found large blocks differing completely from the rock which formed the ground on which they lay. The land on the west side of the Chelyuskin peninsula, at the head of Toll's bay, where I went reindeer-shooting one day (September 8, 1893), had a thoroughly typical till-like appearance. This was a very undulating clay plain, over which were strewn a multitude of large boulders of different rocks, and these could with difficulty be explained otherwise than as being material brought hither by an extensive ice-sheet. This land, too, was of striking resemblance to the plains we know, and which are generally admitted to be glacial ground moraines. The fact that I found an indication of stratification in several places where the clay had fallen away—as, for instance, along the shore and in some stream-beds—can hardly be regarded any longer as an argument against its moraine-like character, as we, for example, know of several incontestable cases of moraines in the south of Norway which have distinct stratification. Even in end moraines such a stratification is commonly found in Norway. It is only a proof that the moraine was formed under the sea.

It may be thought that the glacial traces we found might be owing to local glacier formations; but compare these with what Toll found almost simultaneously with us on the New Siberian islands and at Anabar, where he has pointed out the most interesting remains of an ice-period, and it must be conceded that the probability is that at any rate a considerable part of the north coast of Siberia must have been

buried under an ice-sheet like that which in its time covered the whole of Northern Europe, and the exemption from an ice-period, which it has been endeavoured to grant Siberia, no longer holds good. The entire configuration of the Siberian coast also appears to indicate that it has had an ice-period here, as outside it there lies a belt of rocks and islands such as very seldom occurs, except off glaciated coasts. Moreover, the coast itself, when we approached it, appeared to be much fringed everywhere with deep fjords, such as are seldom found in other than glaciated lands. I should imagine that the whole of the north-west coast is indented in a similar manner, and the impression given by the ordinary maps of a continuous even coast-line is therefore misleading.

The geological structure of Franz Josef Land is of a very peculiar nature. It appeared, wherever we visited it, to consist of basalts. In the northern parts of the islands these basalts and other plagioclase-pyroxene rocks reached the very shore, and I looked in vain for fossil-bearing strata. Further south, however, near Cape Flora and thereabouts, the basalt did not reach to the sea; but, as the Jackson expedition had already discovered, an immense formation of clay stretched from the shore up to an altitude of from 500 to 600 feet, and on this formation the basalt rested to a height of another 500 to 600 feet. I brought home with me a collection of specimens of basalt from the neighbourhood of Cape Flora, as well as from further north. These have been examined microscopically by Professor Brögger. There is a great difference in the basalt in different parts. While in some places it has a decided porphyritic structure, thereby differing from many typical basalts more resembling many melaphyres, to a very great extent the basaltic lavas have an amygdaloid structure. The cavities are filled with zeolites (especially analcime) and calcite; it was in other parts—at Cape McClintock, for example—very coarse-grained in quality, with diabase structure (doleritic structure), and appears to be closely connected with the diabases (dolerites) and basalts found in Spitsbergen, particularly on Stans Foreland and the Stor Fjord as intrusive sheets. The basic rocks of Franz Josef Land seem to have been formed in the Jurassic period, for the clay formation on which they rested at Cape Flora was undoubtedly Mesozoic (Russian Jura, Lamberti-zone), and above the basalt was found, as I shall mention presently, fossil plants belonging to the later Jura period.

It thus appears that Franz Josef Land is, taken altogether, of Mesozoic (Jurassic) formation. These numerous flat basaltic streams, which extend over all the islands at about the same height, seem to tell us that at one time it was a continuous mass of land, which in the course of ages, eroded by the various wasting forces, such as frost, moisture, snow, glaciers, and the sea, has become cut asunder, destroyed, and has partially disappeared under the surface of the sea, while only scattered islands and rocks now remain, separated from each other by sounds and

fjords. These basalts have, as I mentioned before, a striking resemblance to those formed in parts of Spitsbergen; like these, they contain very little olivine and iron ore, and it is probable that Franz Josef Land and Spitzbergen formed a continuous eruptive province, different in age and rocks from the great Tertiary eruptive province of North-Western Europe, Færoe islands, Iceland, Scotland, Ireland, and Greenland.

An interesting discovery was made while we were at Cape Flora. Jackson and the geologist of the English expedition, Dr. Koetlitz, finding one day, on a basalt mountain projecting from a glacier, numerous fossil plants. One day later Koetlitz and I went there together, and made a valuable collection of them. My comrade Johansen also found his way there one day on "ski," quite unwittingly, and also collected fossils, which he brought to me. These fossils have been examined, since our return, by Prof. Nathorst, and it proves that Jackson and Koelitz's find is a highly interesting one. Prof. Nathorst has, in a letter, given me some preliminary information on the character of these fossil plants, and he says that "in spite of their fragmentary character, the specimens of fossil plants brought home are of great interest, as we are enabled through them to get a glimpse, for the first time, into the plant-world which existed in the latter part of the Jura period in the tracts north of 80° N." The leaves of a certain pine, closely connected with the *Pinus Nordenskiöldi* of the Jura strata of Spitsbergen, East Siberia, and Japan, but probably belonging to a species differing from them, are most common. There are also leaves of another kind, the fragment of a cone,* and several seed-vessels, of which one reminds us of the *P. maakiana* from the Jura strata of Siberia and Spitsbergen. Nathorst, in addition, mentions several other conifers, which, however, I will not touch upon here. Interesting, he says, is the appearance of the genus *Feildenia*, as it has hitherto only been known in the polar regions. It was first found by Nordenskiöld, in 1869, in the Tertiary strata of Spitsbergen; afterwards by Feilden, in the Tertiary strata of Discovery bay, in Grinnell Land, during the English polar expedition of 1875–76. It has been found since by Nathorst in Spitsbergen, in the upper Jurassic strata.

The most beautiful in the whole collection are the leaves of a little *Ginkgo*, of which one is complete. This genus, with plum-like seed and with leaves which, unlike those of other conifers, have a real leaf-surface, is now found in Japan in a single species; but it appeared in earlier times in a multitude of forms, and was widely distributed. It was particularly luxuriant in East Siberia in the Jura period, and it is also known from Spitsbergen and Eastern Greenland (near Scoresby's sound), and many places in Europe, etc. The leaf

* Leigh Smith brought home a fossil cone from Franz Josef Land, which Carruthers decided to be that of a pine; but he supposed it to belong to the upper part of the Chalk system

represented here belongs to a new kind, which Nathorst has called *Ginkgo polaris*, and which is closely connected with Heer's *Ginkgo flabellata*.

There are also fossils of several other conifers, which, however, I will not enumerate here. "On the whole," says Nathorst of this Jura flora of Franz Josef Land, "it is, by reason of its wealth of conifers, its poverty of ferns, and its lack of sycads (or, at any rate, great rarity of them), of about the same general character as the upper Jura flora of Spitsbergen, although the species may differ; and it would seem that the flora does not testify to particularly favourable climatic conditions, although the difference between then and now is a vast one. The deposit presumably took place in the vicinity of a forest of conifers. As far as can be judged by the material, the flora must belong to the upper white Jura rather than to the more medium brown Jura."

I will conclude these remarks on the geological investigations with a few words on the present bottom-sediment of the polar basin. By examining with the microscope the samples which we secured by means of our soundings, it proved that they differ essentially from the samples taken from the north Atlantic Ocean, as they are wanting in the organic compounds or shells of marine animals which form such an important ingredient in the ground-mud of that ocean. On examination with acids, it was also shown that this mud is particularly deficient in carbonate of lime, and seems to be chiefly of mineral components. There has not yet been time to subject these samples to very careful examination, and I will, therefore, for the present refrain altogether from attempting any explanation of the characteristic composition of this mud. It appears that a deposit of sedimentary strata is now taking place in the polar basin which, however, may prove to be extremely deficient in fossils.

A very important result of the Norwegian Polar Expedition is the glimpse it has given us into the drift and transport of ice in the hitherto unknown polar sea. As I pointed out before my departure, the plan of the expedition was based on the assumption that a current or continual drift of ice must go right across the polar basin from the sea north of Siberia and Bering Straits, and over towards the sea between Spitsbergen and Greenland. It was with this ice that I intended to let the *Fram* drift. My assumption seemed to be at variance in several ways with the current ideas of the nature of the polar sea. Meanwhile the expedition was carried out in accordance with the plan; it has proved that the premises from which I started were more or less correct, and it has enabled us now to form a fairly complete picture of the manner in which the ice drifts ceaselessly across this basin.

Although, as I say, the assumption of such a drift was at variance with current opinion, something of the kind had already been suggested

in several quarters. I will again refer to the eminent President of the Society, Clements Markham, who, in 'The Report on the English Expedition of 1875–76,' said, twenty years ago, that the water emptied from the rivers of Asia and America into the polar basin "causes a current round the area from left to right, and also across from the eastern to the western hemisphere." As early as 1869 the Swedish naturalist, Professor Agardh, showed that the driftwood of Spitzbergen originated in Siberia. Among the others who made investigations before in the same direction, I must mention Professor Moha, who, when the articles from the *Jeannette* were found in 1884 on the south-west coast of Greenland, pointed out that they must have drifted straight across the polar basin north of Franz Josef Land and Spitzbergen, and down along the east coast of Greenland.

A thing which caused me most of all to place reliance on a drift of this kind being in constant movement across the polar basin, and to think that it might be turned to account for the purposes of an expedition on the plan that we have carried out, was first and foremost the Siberian driftwood which is constantly brought to the east coast of Greenland, and from the earthy matter to be found everywhere on the drift-ice which comes down along the east coast of Greenland. On microscopic investigation of this mud which I had collected, it proved that it could not well proceed from anywhere else but from Siberia. During our journey we again found, ourselves, the same proofs of the origin of the ice; I found earthy matter on the ice as far north as 86° N., and driftwood likewise. I remember one day far north, during Johansen's and my journey over the ice, our astonishment at seeing a large piece of timber projecting from the ice; it hailed perhaps from the interior of Siberia, and was on its way to the Eskimo of Greenland. The only thing we could do was to cut our initials on it, with the date and latitude, in the hope that it might take a greeting to some acquaintance away in Greenland. We often found similar driftwood in the neighbourhood of the *Fram*. Sverdrup once found a half-rotten piece of timber which was firmly frozen into the ice—this was in April, 1896. When, about a month later, he came across the log again, he was astonished to find that it had been broken off and dragged some distance away. The bears had, no doubt, been amusing themselves by exercising their strength.

But what causes the drift of this ice over this sea? It is first of all the winds. The prevailing winds blow from the Siberian sea towards the north Atlantic Ocean, and they do, in course of time, carry the ice over in that direction. But the winds are, as we know, very irregular forces with which to deal, and in consequence of this the drift is not particularly regular either. Sometimes there are stoppages, sometimes a return drift, sometimes even a drift sideways; but, on the whole, it proved that every time the wind carried us in the right direction—

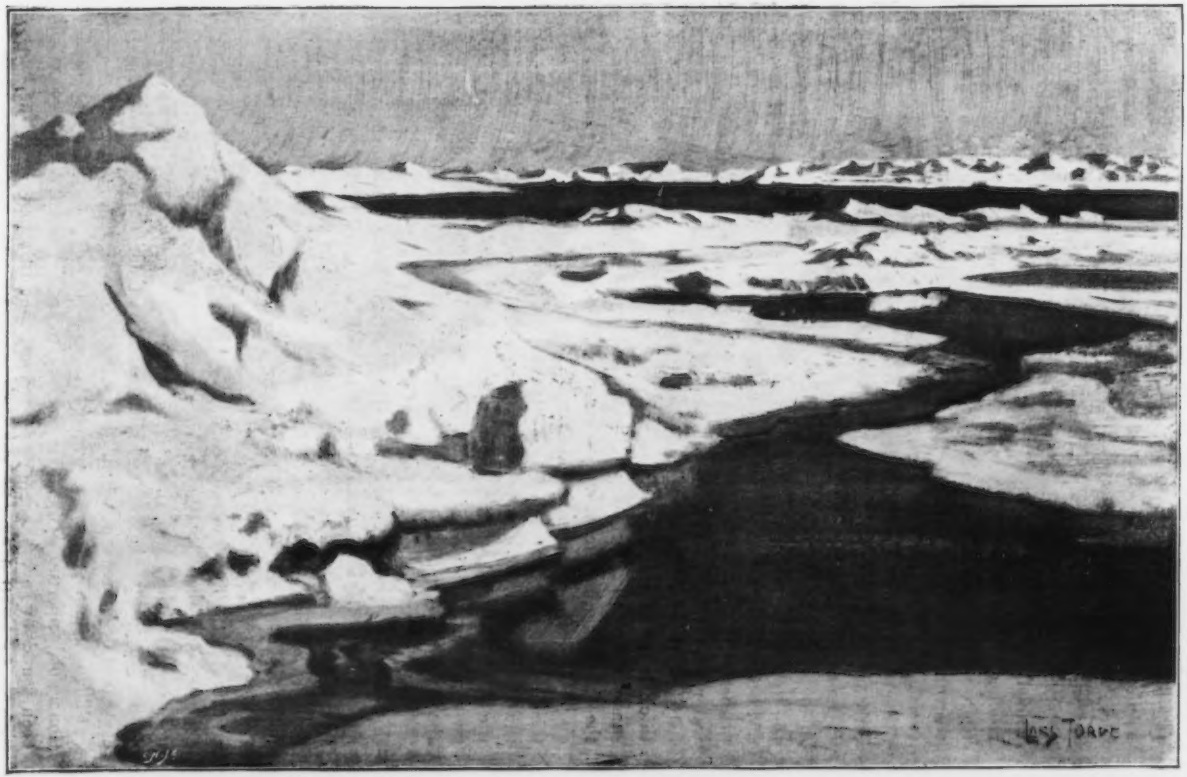
PECULIAR ICE-STRATIFICATION, APRIL, 1895.

towards our goal—the drift became very rapid. On the other hand, if the winds came from the contrary direction, setting us back towards the south-east, the masses of ice were very sluggish and difficult to set in motion; it seemed as if something were keeping them back. As the prevailing winds change very much with the season of the year, our drift was also very periodical.

As a rule the wind was most favourable in the winter; in the summer—particularly the latter part of the summer—it was as generally unfavourable. No sooner were we fast in the ice the first autumn, than we experienced an unfavourable period and were set back towards the New Siberian islands; this was a very dark period in our drift, and everything seemed to go backwards. Then came the winter with good progress, until from June onwards to the autumn of the next year there was again retrograde movement. Then came another winter with good progress, and we gained a point north of 84° N. The summer following this was not particularly favourable either, but the succeeding winter—it was last winter—sent the *Fram* right north again to 86° N. Then came the spring with a long pause in the drift of the *Fram*, until she finally broke loose out of the ice as far north as above 83° N. and made her way down to Spitzbergen—a distance through which no vessel has hitherto broken its way through ice so massive as that which there surrounded her. But, according to my opinion, it is not merely chance winds which influence the drift of the ice; I thought, too, that at times there was evidence of a slight current in the water, under the ice, which also went in about the same direction. Nor do I think that the drift of the ice quite coincides with the direction of the prevailing winds. I had the impression that it often carried us a little further north than did these latter; but our abundant material is not yet calculated out, and before this is done it will not be possible to say anything for certain on the subject.

Our experience with regard to the drift provides a complete picture of how this ice is in continual motion; how there is not a single stationary spot on the whole of this great sea-surface covering the region around the pole. From the whole of this area the winds and the current carry the ice out towards the openings which lead to the Arctic Ocean, chiefly through the large gap between Spitzbergen and Greenland, but also down through the narrower sounds between Greenland and the islands of the North American archipelago. The massive ice-mantle, with which so many of our great polar explorers have sought to cover our pole, has disappeared. Instead of it, we have the ever-wandering ice-fields like a link in the eternal round of nature.

Of the character, formation, and freezing of this ice, our expedition has gleaned valuable information. It would, however, lead me too far away to enter more fully upon this subject, and I will confine myself to the mention of the thickness which this ice attains by direct



CHANNELS IN THE ICE, JUNE 24, 1895.

freezing. As soon as this ice is formed it grows very rapidly, but as the thickness increases the growth becomes slower and slower, as the loss of heat, by radiation during the long winter night, has then more difficulty in penetrating down to the underside of the ice. The ice which was formed in October and November of the first autumn, 1893, had in April, 1894, attained a thickness of 7½ feet, but it continued to increase steadily during the summer. On June 9 it had reached a thickness of 8 feet 3 inches, and this in spite of the fact that there was already a severe thaw on the surface caused by the rays of the sun. On June 20 the thickness was still the same; the thaw on the surface was considerable, and there were large fresh-water pools in every direction. The rest of June the ice continued about the same, until on July 10 it suddenly received a new layer underneath, so that altogether it measured a thickness of 9 feet, despite a decrease by thawing of an inch or two a day on the surface. This formation of new ice on the underside was owing to the layer of fresh water, which, by reason of the surface thaw of the ice, now floated above the cold salt water, the temperature of which was considerably below the freezing-point of fresh water, and which cooled the latter off so effectually that at the line between the fresh and the salt water, at a depth of about 8 feet, a thick layer of fresh-water ice was formed. This lasted through the summer, but then began to decrease slowly—the united thickness of the old layer plus the new layer—until in September the thickness was about 6½ feet. The growth began again in October; on November 10 the thickness had become 6 feet 7 inches; on December 11, 7 feet; and thus it continued to grow slowly during the winter. On February 6 the thickness was 8 feet 4 inches. During the spring the ice went on growing; on May 11, 1895, it had become 9 feet 10 inches; and it was about the same on May 30.

It will thus be seen that the ice does not attain any excessive thickness by direct freezing, and this ice had made the journey from north of the New Siberian islands to the sea north of Franz Josef Land, that is to say, across no inconsiderable part of the polar basin. A floe which was measured the following winter on November 4, 1895, was 11 feet thick; it continued to grow thicker during the course of the winter; and on May 4, 1896, had reached 13 feet 6 inches—quite a respectable thickness when it is a case of forcing a ship into it. But the ice, of course, attains much greater thickness by the constant upheaval from pressure, and it is the enormous piled-up hummocks and rubble caused by this, coming down with the polar current along the east coast of Greenland, which give this drift-ice its character.

The constant pressure to which this ice is subjected gave the expedition a good opportunity of making observations. It proved, as has already been found by several earlier expeditions, that this pressure is dependent in no small degree on the tidal current. This was particularly

OUR WINTER HUT, DECEMBER 31, 1895.

the case on the outer margin of the polar basin in the proximity of the open sea. Thus, for example, the pressure in the ice during the first autumn, 1893, was so regularly dependent on the spring tides, that we could almost say beforehand when it was going to take place. We had two regular recurrences during the month—a period at new moon, when the greatest pressure took place; another period of less pressure at full moon. At these periods the pressure would recur twice during the twenty-four hours, and could be rather violent.

A similar, regular, tidal pressure was experienced by the *Fram* during the last spring and summer, when she had entered the sea north of Spitzbergen; the pressure recurred at such regular intervals that during one week in July, the *Fram* was twice a day gently and steadily lifted up, almost out of the water, by the ice, which then closed together again around her. The pressure was less regular in the interior of the polar basin, particularly during the winter. It sometimes happened, for instance, that when the wind had been blowing for a long time from the south-east, and the ice had got into a good drift in the right direction, and the wind changed suddenly in order to drive the ice into other paths, the latter would, in a way, make resistance by its sluggishness, and violent pressure ensued. The chief mass would come pressing onwards from behind, while other masses of ice further in front were set in motion towards it. If the wind went over to the south-east again, the pressure would cease altogether. It was pressure of this kind to which the *Fram* was subjected at New Year, 1895, and which seemed to have the greatest desire to bury her.

By this movement of the ice, occasioned partly by the tide, partly by these winds, seams and lanes are formed in it, which often run at right angles to the direction of the movement. These lanes often have a great extension, and form large lakes. When, then, pressure suddenly takes place, the ice at either side of these seams and lanes is forced forward, the floes partly underrun each other, are partly piled up in long ridges (*skrugarer*), which consequently come to assume a position at right angles to the direction of the movement. By degrees, as this direction changes, the new ridges cross and recross each other, until the whole surface of the ice is cut up into an intricate network of lanes and ridges, which make progress with sledges and dogs a very difficult matter, as Johansen and I experienced during our journey in 1895.

Investigations as to the temperature and the various depths of the sea-water were made during the entire drift of the *Fram*. As is known, the water which floats from the east Greenland polar current into the Atlantic Ocean is extremely cold to a great depth, and therefore the whole of the north Atlantic Ocean is filled deeply with cold water from the Arctic Ocean of a temperature of 29·3° Fahr. (−1·5° C.). It was, therefore, perhaps to be expected that a similar temperature would be

found in the entire polar basin from surface to bottom. I had, indeed, had my daring doubts of this beforehand, seeing that I assumed the Gulf Stream to enter this basin from several quarters, as I represented at the meeting of the Society before my departure, and I thought that a current of this kind must make its influence felt. Great, however, was my astonishment when, as far east even as the sea north of the New Siberian islands, I found undoubted traces of such a warm current. The surface-water of the entire polar basin is, no doubt, very cold, seeing that it keeps to about the freezing-point of salt water, *i.e.* 29·3° F. to 29·12° F. (−1·5° to −1·6° C.). When, however, I penetrated through this layer to a depth of 200 metres (110 fathoms), I suddenly came on warm water, the temperature of which would be as much as 32·9°, even 33·44° F. (+0·5° C. and + 0·8° C.). At a greater depth the temperature varied somewhat, but remained about the same to a depth of 400 to 500 metres (220 to 270 fathoms), after which it sank slowly towards the depths, though without sinking to the cold temperature of the surface-water. Near the bottom it again rose quite slowly. These conditions were fairly uniform in that part of the sea over which we travelled, and where investigations were made; when I, therefore, give one such series of temperatures from the surface to the bottom, it will be sufficient to characterize the conditions taken as a whole.

Temperature Series, taken August 13–17, 1894.

	C.	F.		C.	F.
Surface*	+ 1·92°	= 35·60°	450 metres ...	+ 0·36°	= 32·65°
2 metres ...	− 1·32°	= 29·63°	500 „ ...	+ 0·34°	= 32·60°
20 „ ...	− 1·33°	= 29·61°	600 „ ...	+ 0·20°	= 32·36°
40 „	− 1·50°	= 29·30°	700 „ ...	+ 0·14°	= 32·25°
60 „	− 1·50°	= 29·30°	800 „ ...	+ 0·07°	= 32·12°
80 „	− 1·50°	= 29·30°	900 „ ...	− 0·04°	= 31·93°
100 „	− 1·40°	= 29·48°	1000 „ ...	− 0·10°	= 31·80°
120 „	− 1·24°	= 29·77°	1200 „ ...	− 0·28°	= 31·50°
140 „	− 0·97°	= 30·26°	1400 „ ...	− 0·34°	= 31·40°
160 „	− 0·58°	= 30·96°	1600 „ ...	− 0·46°	= 31·17°
180 „	− 0·31°	= 31·44°	1800 „ ...	− 0·60°	= 31·00°
200 „	− 0·03°	= 31·90°	2000 „ ...	− 0·66°	= 30·80°
220 „	+ 0·19°	= 32 34°	2600 „ ...	− 0·74°	= 30·67°
240 „	+ 0·20°	= 32·36°	2900 „ ...	− 0·76°	= 30·64°
260 „	+ 0·34°	= 32·60°	3000 „ ...	− 0·73°	= 30·69°
280 „	+ 0·42°	= 32·75°	3400 „ ...	− 0·69°	= 30·76°
300 „	+ 0·34°	= 32·60°	3700 „ ...	− 0·65°	= 30·83°
350 „	+ 0·44°	= 32·80°	3800 „ ...	− 0 64°	= 30·85°
400 „	+ 0·35°	= 32·63°			

These water temperatures are remarkable in several ways. First, the temperature, as it will be seen, sinks from the surface down to 80

* Two metres are equal to about $1\frac{1}{10}$ fathom. Roughly, metres may be converted into fathoms by dividing by 2.—Ed. *G. J.*

metres; it then rises till a depth of 280 metres is reached; sinks again at 300 metres, and again rises at 325 metres (where it was 32·88° F. = + 0·49° C.). It then sinks to rise again at 450 metres, then sinks steadily down to 2900 metres, and rises again slowly towards the bottom. Similar risings and sinkings were found in nearly all the temperature series, and the variations from the one month to the other were so small that at the different depths they often only amounted to a couple of hundredths of a degree. Sometimes, however, the temperature in the warm-water layers would rise higher even than is here given. Thus, on October 17, the temperature at a depth of 300 metres was 33·52° F. = + 0·85° C.; at 350 metres, 33·36° F. = + 0·76° C.; at 400 metres, 33·40° F. = + 0·78° C.; and at 500 metres, 30·11° F. = + 0·62° C., after which it sank gradually until towards the bottom it began to rise again as noted above.

I have now mentioned most of what it is possible for me to enter upon here. There is still a great deal which ought also to be noticed, but this does not lend itself to discussion at present, as the material must first be worked out. This is particularly the case with the meteorological observations, which, being extended over a period of three years, will afford a valuable contribution to the understanding of the climatic conditions of these regions. I can, nevertheless, say as much as that our observations did not bring to light any meteorological surprise, as did those on our expedition across the "inland ice" of Greenland. The temperature seems to be distributed over this sea in about the same manner as might be assumed beforehand; and when, in setting forth my plan of the expedition, I represented that the winter temperatures in the unknown polar sea would probably be found to be higher than those of Siberia, for instance, I was correct. The sea seems to make its presence felt here, and our lowest temperatures (− 62·6° F. = − 52·6° C.) were not immoderately low, when it is remembered that in Verkhoyansk, in Siberia, which is inhabited, temperatures as low as − 90° F. = − 68° C. have been registered.

The weather in the winter up there was unusually clear, and often for a long time together there was not a cloud in the heavens. In the summer, when there were open lanes and the snow melted on the floes, there could, however, be much mist, even in the interior of the polar basin. On the whole there seems to be much equableness in this atmosphere, and the winds were not particularly strong; they seldom amounted to what we should call a gale here. This was most apparent in the eastern part of the polar basin; but by degrees, as we approached the Atlantic and the parts between Spitzbergen and Greenland, there was a change in this respect, the winds sometimes blowing with much greater violence. There was, however, a conspicuous difference, on the whole, between the winds and the climate in the north along the *Fram's* route in the drift-ice, and the climate which Johansen and I experienced

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WALRUSES.

during our winter in Franz Josef Land. If in the north, in the long still winter night, there had been a remarkable quiet and equableness, the reverse was now the case. Storms howled round us continually. Matters came to such a pass that one day the wind even carried away Johansen's kayak, and we nearly lost it altogether in the darkness. Another day my sledge went off. A third day a ski, which was standing up in the snow by the side of the hut, had the end blown right off; and although the temperature in Franz Josef Land was very much milder than that we had experienced north in the polar basin, yet it cannot be denied that now and then we both longed for the profound stillness we had left behind.

We had unusually good opportunities of observing the northern lights, and they were exceedingly frequent. I think I may say that not a single night or day passed during the winters up there without the aurora being seen, provided the weather were clear enough for it. Furthermore, I must mention that it appeared to me that the sky was always covered by a faint even veil of light, which, as far as my spectroscopic investigations could determine, seemed to be a constant aurora-veil. This veil was thick enough to almost hide the Milky Way, so that we could never discern it with certainty. On the whole I received the impression that the aurora-belt which surrounds the pole extends, on this side, a good deal further north than is generally supposed. I also made observations with regard to the electricity of the atmosphere. This seems to vary very much, and at times was considerably greater than has generally been supposed; at other times it was quite difficult to show any trace of electricity. Lieut. Scott-Hansen made a long and valuable series of magnetic observations during the three years. It is to be hoped that when this material has been worked out, it will afford valuable contributions to the comprehension of this difficult subject.

With regard to animal life in these parts, there is a good deal that is new to be told, which space, however, does not admit of. There were naturally numerous animals, particularly crustaceæ, in the sea, even in the highest latitudes. As a remarkable fact in this respect, I must mention that even north of 84° N., and near 85° N., schools of narwhals were observed near the *Fram*—a proof that they must be able to find sufficient nourishment in this sea. Seals were frequently seen in the summer, and the first winter I even came across a walrus in the middle of the sea between the New Siberian islands and Franz Josef Land. What it was doing there is still a puzzle to me. Bear were shot on board the *Fram* north of 84° N., and Johansen and I saw the tracks of foxes in 85° N. It will be seen by this that even mammalian life exists very far north on our globe, and it may even reach the pole itself. We saw birds every summer. I think I have made quite an interesting discovery in the number of the mysterious Ross's gulls, or

roseate gulls (*Rhodostæthia rosea*), that we saw on the north side of Franz Josef Land, near the islands discovered by us, *i.e.* Hvidten Land. They were so common that I have no doubt whatever that they have breeding-grounds in the neighbourhood. Unfortunately, time did not admit of our investigating this further. On board the *Fram*, too, we shot several specimens of quite young birds of this species in their hitherto unknown garb.

While speaking of animal life in the far north, I ought perhaps to mention the vitality I found in the summer in the pools on the drifting ice. As soon as the summer sun is able to melt the snow off the ice in these parts, a comparatively rich plant and animal life begins to develop in the fresh-water pools caused by the thaw on the surface of the ice. They look like brown patches and accumulations, and might easily be taken for mud, but under the microscope they reveal themselves to be pure vitality—chiefly minute plants, diatoms, and some algæ. But among these there also exists a crowd of tiny microscopic animals—infusoria—and I also discovered small bacteria, so that even these regions are not free from this noxious animal. It is a remarkable proof, in my eyes, of the fruitfulness of Nature: even on this ice she finds conditions for the calling forth of life.

Before concluding this paper, I must point out what suggestions the expedition may possibly afford to the future exploration of the regions of the polar sea which are still unknown. First of all, I think, the expedition has clearly proved the efficiency of the mode of travel which we adopted. That a ship can be built able to withstand the pressure to which it would necessarily be subjected on a drift through these regions, I think we have proved. It can hardly be doubted that the *Fram* was exposed to difficulties of this kind as great as can reasonably be imagined. Worse pressure than that we had in January, 1895, I, at any rate, have never heard of. The *Fram* was at that time beset in ice over 30 feet in thickness; the temperature was very low so that the ice was about as hard as it could be, and during the pressure a prodigious ice floe overran the thick floe in which the *Fram* was beset with tremendous force against her port side. For the first time the *Fram's* timbers creaked and groaned; it seemed almost incredible that human work should be able to withstand where such stupendous forces were set in motion. But the *Fram* held her own, broke loose from the ice, and rose slowly from her icy bed without a hint of damage in any part of her. I infer from this, and several similar experiences, that the polar sea can be traversed with reasonable safety in the manner we adopted, if only proper provision be made. One is exposed to dangers, of course, though they are not so great as those entailed by many other modes of travel; and given this to be the case, then I think this manner of travelling offers such great advantages that it is quite warrantable, and ought to be adopted in the future,

seeing that a ship drifting like the *Fram* through unknown regions affords the best means of making scientific investigations of all kinds. It is only by a sojourn of years that sufficient material can be collected to enable a fully satisfactory conception of the physical conditions of these regions to be formed. In a vessel like the *Fram*, it would be possible to take on board with one laboratories where even the most elaborate scientific investigations could be made. Could an expedition of this kind go north through Bering Straits and enter the ice thence in a northerly, or perhaps north-easterly direction, I think it would bring with it, when it eventually emerged into open water on this side of the pole, a sum of information which would quite put the *Fram* and her men in the shade.

But such a drift would take a longer time than ours did, and, many people might urge in objection, would expose its members to certain dangers, as it is stated that a sojourn of years in these parts would be injurious to health. I cannot, however, agree in this. From my experience, I must say that I found the arctic regions a very healthy place of resort, and as a proof of this I may mention that when I returned from wintering on Franz Josef Land I was stouter than I had ever been in my life before. On the trip from the *Fram* to Jackson I gained no less than twenty-two pounds in weight. Something of the same kind was also my experience when on board. As far as I could see, the rest of the party were perfectly well, and the physiological examinations which were made on board seemed to point in the same direction. This may be very important material for coming expeditions, and will throw light on the hygienic conditions during our expedition; but, unfortunately, the material is not sufficiently worked out to allow me to set it forth here. I dare only say that the malady which has hitherto been feared more than anything else in arctic exploration ought not to occur again, as it is undoubtedly very easily avoided when proper precautions are taken.

Dr. Torup, professor of physiology at the University of Christiania, has come to the conclusion, after examining the subject, that scurvy must arise from poisoning, caused, in particular, by badly preserved meat and fish. He thinks that in the decomposition which takes place in the meat from bad preserving—in salt meat, for instance—there is poisonous matter allied to the so-called ptomaines, which, when constantly partaken of, engenders the malady we call scurvy. Particular attention was paid to this at the time of our equipment, and from our experience and the investigations I had the opportunity of making during our journey, I can entirely subscribe to Torup's opinion in this matter. It is to be hoped that in a near future there will be scientific elucidation of this important point; and it is equally to be hoped that certain means for avoiding this hitherto so fatal disease may be shown.

Another thing with regard to the mode of investigation of the arctic regions which our expedition learned was perhaps this—that even with small means good results can be obtained. By acting on the hints given by the Eskimo, and pushing forward with "kayaks," sledges, and dogs, one is enabled to penetrate into and cover considerable distances in regions which have hitherto been considered very difficult of access. In this way the drift-ice itself can be travelled over at a considerable distance from land—even where it is in motion; and I think this must be one of the ways in which it should be endeavoured to investigate the great unknown region between the North American arctic archipelago and the pole. Here, no doubt, many interesting problems are awaiting their solution. May a not far-distant future see those tracts traversed by human feet!

THE NORTH POLAR PROBLEM.*

THE PRESIDENT: When Dr. Nansen was so good as to read us the interesting account of his expedition last month, owing to the peculiar circumstances of the occasion we were unable to take the usual discussion of the paper at that time. I therefore propose that we should take it this evening, and I shall read a short paper intended as a hook upon which the discussion may be hung.

It has taken centuries to obtain even a very general idea of the north polar region. Three centuries ago Mercator adopted the theory, which was derived from the mysterious Nicholas of Lynne, that four great rivers flowed down a chasm at the pole. Later there was Maury's theory of an open polar sea; and the most recent opinion that has prevailed was that the polar sea was shallow, with land, in the form of islands, extending north from Franz Josef Land.

Facts could not keep pace with theories, but they have gradually and painfully refuted them, and revealed to us the truth. It has long been known that a great stream of heavy ice flows down the east coast of Greenland. The archipelago of ice-capped islands, known as Spitsbergen, had its general outline made known by British seamen 270 years ago; and more recently it has been ascertained that the sea to the north of it is of great depth; while warm currents, proceeding from the Gulf Stream, flow up the Spitsbergen western coast, and eastward to Novaya Zemlya. The coast of Siberia was also known to be bordered

* Report of a discussion at the Royal Geographical Society, March 22, 1897. Map, p. 588.

by a sea of comparatively light ice, with frequent *polynias*, or pools and lanes of water, described by Wrangel, even in the winter.

The American side of the polar sea was gradually discovered to be of a very different character. Collinson found that very heavy ancient ice formed the pack from Bering strait to Franklin bay, only a narrow lane being kept open by the current of the Mackenzie and Colville rivers, between the land and the pack. M'Clure discovered that the same ancient ice extended along the whole western shore of Banks island. The surfaces of the floes resemble rolling hills, caused by the accumulated action of repeated thaws and the almost constant fall of snow on the upper surface, giving it a peculiar hill-and-dale appearance. Mecham found the same ancient ice along the western shore of Prince Patrick island. He described it as "tremendous," and he came to the conclusion that the sea on which it floats was of great extent. Parry met with this ancient ice when he attempted to go westward from Melville island, and it flows down McClintock channel south-east until it impinges on the coast of King William island. This stream was met with by Sherard Osborn and Vesey Hamilton on the western shore of Prince of Wales Land; and it stopped the progress of Sir John Franklin's ships to the American coast. Sir George Nares's expedition met with the same ancient ice extending for 300 miles along the northern coasts of Grant Land and Greenland. It was found to consist of small and rugged floes, separated by ranges of hummocks, from 30 to 50 feet high. The surfaces of the floes were studded over with rounded blue-topped ice-humps, the depressions between them being filled with snow, deeply scored into ridges by the prevailing wind. Every indication pointed to the conclusion that there was no land to the northward. But the sea was supposed to be shallow, because there were only 72 fathoms of water at a distance of 40 miles from the shore, and because the positions in which driftwood was found furnished an argument that there had been a general recent upheaval of the adjacent land. Huge masses of grounded ice, along the shore, were believed to have been broken off from large floes of ice, and were called "floe-bergs." The floes themselves are of enormous thickness, formed by continual accumulations from the annual snowfalls, which, by the increasing additions from above, are gradually converted into snow-ice. The process of formation of this ancient ice thus resembles that of glaciers, and the ice broken off from it has all the character of icebergs. It is deduced, from similarity of tides, direction of prevailing winds, and movements of the ice, that the line of ancient ice continues south-west to Prince Patrick island. The same reasons exist for the belief that Greenland does not extend far to the north, and this view is also confirmed by Prof. Houghton's study of the tides. The ice is subject to annual disruption during the summer months, and is in motion, driving backwards and forwards with the winds and currents, its main course being towards the east.

We thus find that this line of ancient ice extends from Bering strait to the north coast of Greenland, a distance of 1200 miles, for that it is continuous across the gap of 400 miles between Prince Patrick island and Aldrich's farthest is deduced from the coincidences of winds, tide, and drift. The fact that the heavy ice actually reaches the western part of the North American coast seems to indicate that there are no intervening lands, of any extent, to the westward of Prince Patrick island.

The discovery of Franz Josef Land brought to our knowledge a group of volcanic islands of the same geological period as Spitsbergen, approaching Spitsbergen closely at its western end, and on the same bank; in short, a continuation of the Spitsbergen group. Beyond this bank, the European polar sea was found to have a depth of 2000 fathoms south-east of Jan Mayen, 2650 fathoms between Spitsbergen and Greenland, and 1370 fathoms north of Spitsbergen. It was a correct deduction to assume that to the north of Franz Josef Land, which is but a part of the Spitsbergen group, there is the same deep polar sea.

There is an eastward drift of the ice on the coast of Grant Land; and it was assumed that there was a general drift of ice across the polar basin from the eastern to the western hemisphere, as well as a drift from left to right, due to the flow of warmer water into the polar area, which, as a cold current, seeks an outlet southward at every opening, owing to the polar area itself being surcharged, but only finds it for the ice it bears on its surface along the east coast of Greenland. The warmer water comes to the surface along the Siberian coast, and, aided by the outflow of the Siberian rivers and the prevailing winds, forms a current northwards across the polar area.

These were the conclusions which were derivable from the facts within our knowledge before the departure of Dr. Nansen. His return, with the rich fruits of his expedition, has thrown new light on the whole question, and, as I said on a former occasion, the north polar problem begins to take definite shape. Nansen's chief discovery is that there actually is a very deep sea north of the Franz Josef group, continuous with that which was known to exist north of Spitsbergen, and that this deep sea has a relatively warm temperature in its depths. He ascertained that the time occupied by the ice, in drifting across the polar basin on the parallels of the track of the *Fram*, is a little over three years, and that the ice-bearing ocean extends at least as far as the pole. For the *Fram's* track southwards to Spitsbergen leaves a great width thence to Greenland, down which a vast volume of ice drifts, which must necessarily come from a region north of the track of the *Fram*.

The question remains to be decided whether there is land of any extent in the vast unknown region between the Parry islands and the

New Siberian group. At one time I held the opinion that a chain of islands probably did exist, extending from the neighbourhood of Prince Patrick island towards Wrangel island. This opinion was solely based on considerations connected with the apparent line of Eskimo migration from Melville island to Greenland, as indicated by a continuous series of remains. But I now concur with Dr. Rink that these vestiges are due to visits from the American continent in times past. The presence of the ancient floes of heavy ice along the north shores of the American continent is evidence that no land of any size exists to the northward, on the meridians from Bering strait to Franklin bay. In fact, I am disposed to regard the whole line of heavy ancient ice which presses upon the shores of the American continent, of the Parry islands, and of the northern side of Greenland as evidence of a continuous drift from the eastern to the western hemisphere, across an ocean uninterrupted by land of any magnitude.

The presence of warmer water in the depths of Nansen's polar sea is an important discovery. It commences 100 fathoms below the surface, and extends down to 250 fathoms.* If this warm current originates in that which flows up from the North Atlantic, Prof. Mohn has observed that its greater salinity, and consequent greater density, would keep it in the depths when it cools down, while the water from the great rivers would be much lighter, and continue on the surface. But there are, I believe, other opinions respecting the origin and eventual destination of this warmer undercurrent in the polar ocean, respecting the part it plays in the economy of that ocean, and respecting the causes of its long retention of some of the warmth derived from the equator.

The study of the currents, and still more of the meteorology of the polar ocean, as observed on board the *Fram*, will certainly throw further light on the polar question, for the observations are continuous during three years. Moreover, they cannot fail to have a practical bearing on atmospheric problems further south, and to increase our knowledge of the causes which influence meteorological changes. Much importance must also be attached to the magnetic observations taken by Lieut. Scott Hansen, after receiving instruments and instruction from Prof. Neumayer, of the "Seewarte" at Hamburg. Our knowledge of terrestrial magnetism is very incomplete, especially as regards the polar, and more particularly the south polar, region. Apart from the practical importance of the magnetic observations, it may well be that the curves of inclination, when plotted, may, with reference to points of greatest intensity, indicate the presence or absence of land over parts of the polar area.

The distribution and limits of animal and vegetable life is another help to a solution of the problems connected with the polar region.

* Surface, −1·6° C. (31·70° Fahr.); 100 fathoms, +0·8° C. (33·44° Fahr.).

Diatomaceæ and other minute organisms are reported to be abundant, but the larger forms of animal life appear scarcely to exist on the sea of ancient ice. Nansen's expedition only saw little auks which live in the lanes of water formed by the drifting ice, and a few dovekeys, and the only cetaceans were narwhals. Yet wherever there is land the land-arctic forms are met with, and the absence of flights of land-birds, such as Brent geese, to the northward, is an indication of the absence of land. The great polar sea is probably a sea without islands, and if so, it is a sea of solitude.

Looking back into past ages, we may discern the evidence of great changes in the polar area, as throughout the Earth's surface. The Spitsbergen archipelago, including Franz Josef Land, seems to be the broken fringe of a continent which, in the Jurassic age, was clothed with pine forests. At a still later period there was abundant arborescent vegetation in Grant Land, and it is probable that the conditions within the vast area of the polar ocean were then very different. From a geological point of view, there is much food for reflection, based on the knowledge we already possess respecting the north polar region; and much further research is needed, especially with regard to the upheaval of the land, which is reported from so many directions. A geological point of special moment is the extent to which the polar phenomena of an extensive land mass in the south, and a deep ocean in the north, are illustrative of and explicable by the theory of earth-folds.

In reviewing the whole polar question, it will be seen that great progress had been made towards its solution, in various directions, before the departure of Nansen's expedition, but only fragmentarily and by side lights, while even the collected facts were often misinterpreted and misunderstood. I consider that the light thrown upon it by Nansen has not only extended our knowledge positively, but has had the effect of piecing together what appeared before to be fragmentary, and of making the detached pieces fit into their proper places and form a consistent whole. There is much, no doubt, that needs discussion and a free interchange of opinions, both on the broad aspects relating to the physical geography, and to the special subjects of oceanography, meteorology, terrestrial magnetism, biology, and geology, on which I have touched very briefly.

There is, however, still much to learn. An expedition should be sent up Jones sound to connect the 400 miles between Prince Patrick island and Aldrich's farthest, and to examine the line of ancient ice in that unknown region. Another expedition should complete the examination of the northern side of Greenland. A third should be equipped on Nansen's plan, and sent to carry out Nansen's principle, by commencing the drift much further to the eastward, and passing over the pole itself. This would probably occupy four years, but it would bring back a further instalment of knowledge respecting the depths of the ocean

the currents and temperatures of the vast unknown area, and another series of magnetic observations. It should also decide the question of the existence of land between Prince Patrick and Wrangel islands.

It is true, therefore, that much remains to be done. Still, we already have a large mass of facts respecting the polar region, from which scientific deductions may be drawn, and this has been enriched and materially increased by the labours of Nansen and his gallant companions. On the various points of scientific interest which I have very briefly enumerated, I would now invite discussion; for such an interchange of impressions made on the minds of trained scientific men by the facts brought home by explorers, is of incalculable advantage in the prosecution of further research.

Dr. NANSEN: I must first express my great pleasure at being asked to speak on this occasion. I can assure you I feel highly honoured at being allowed to open the discussion on this most interesting paper by our distinguished Chairman.

It is very difficult in a few words to point out what may be of importance to discuss in a subject of such vast bearing. I shall, however, first only speak about these points which I think may be of most importance in connection with our expedition. I think that of specially great interest is what we have found as to the extension of sea in the north polar regions. We have seen that the whole sea to the north of Siberia is a very deep basin with comparatively warm water. We have seen that the sea-basin of the north polar region is only a continuation of the deep basin stretching northwards between Spitsbergen and Greenland, as our President has already pointed out. We knew before that for some distance north we had deep water. On the other hand, we knew that the depths to the north of Siberia and America were very small—80 fathoms at the greatest. Now we have seen that this deep sea-basin stretches eastwards as far as the New Siberian islands. All this part of the north polar sea is deep sea, averaging 2000 fathoms deep, and of course you cannot expect this sea-basin to stop here. We may expect it to stretch further eastward—as we see from the route of the *Jeannette* that the sea was getting deeper to the north very quickly; in a short distance it grew from 40 to 80 fathoms. Consequently, I believe we may consider the whole sea to the north of Siberia to be one extended deep sea-basin. I think we can with great certainty say that the pole itself must be situated in this sea-basin. If the *Fram* had not worked herself southwards out of the ice, it is quite certain she would have drifted further in a south-westerly direction along the coast of Greenland. But we could not expect to have got quite close to this coast, as, if the direction of the drift had continued, she would have come southward nearer to the outer margin of the current. Then there would have been a broad current of ice running out from the polar sea

between the probable route of the *Fram* and the east coast of Greenland. All this ice must come from some part of the polar sea north of the route of the *Fram*. It is, in a way, the same condition as we have with the great inland ice of Greenland, which has a great inner basin of heaped-up snow year after year, and all this must have some outlet somewhere. The inner ice of Greenland finds its outlet through the ice-fiords where the icebergs are produced. In the same way we may consider the polar ice in the polar basin; it must have an outlet somewhere, and the only one of importance is the one we have by Greenland; therefore most of the ice produced over this area is probably forced by wind and currents out this way. Some part of it is also pressed against the coast of America, and out through the sounds in the American archipelago. Now, it is evident, if the *Fram* had come down by the coast of Greenland, there would, as I have said, been a belt of ice between her and the coast; this ice must, however, represent an extended area to the north from which it originates, for the current runs at much greater speed in the south than in the north. It will consequently be much broader in the north, and probably will go beyond the pole. I think this one of the best evidences that the sea also has a great extension to the north. There were also others, *e.g.* the drift-ice always easily drifted northwards. The most difficult direction to drift in was constantly in a south-easterly direction; but it always went on easily in a north or north-westerly direction when the wind began to blow from the south or south-east. This proves there cannot be much land to the north, because if there were extensive land it must stop the drift of the ice in that direction. It also seems, according to the experiences and observations during Johansen's and my sledge journey, that the ice drifted with more speed in the north than in the south. It was more broken up, there was more motion between the floes, and in the water channel the current was often running pretty hard.

As the President has already mentioned, no land-birds were to be seen flying northwards. This also indicates the absence of land to the north, for if there were land there would probably be land-birds of some kind. We don't know any land yet where there are not birds.

I agree with the President that the polar ice seems to prove there cannot be much land to the north of the North American archipelago. I think it is probable we may find some islands; but land of great extent cannot easily exist between the islands we know and the New Siberian islands.

I should like to hear Admiral Sir George Nares's opinion about the great palæocrystic ice north of Greenland. I have some doubt whether that ice is really polar or sea ice; whether it is not glacial ice coming from some of the glaciers of Greenland or Grinnell land. The only difficulty would be if the ice Albert Markham met with during his journey is of the same description, because it would be difficult to make

the glacial ice drift far out to sea. The layers described by Dr. Moss makes it in my opinion probable, or at any rate possible, that it is glacial ice, because I believe it difficult for the real sea-ice to remain for such a long time as to obtain so many layers as seem to have been found. Sir George Nares would be able to give a better opinion on that ice than I could; however, if it is sea-ice, that may prove, I think, that there are islands in the north where the sea-ice can be closed up for some time in order to get these layers of snow heaped up annually on it. During the drift this stratified ice can hardly be formed, as I don't think the ice would take so long to drift across the polar region that many layers could be formed; the oldest ice we saw during our journey—and we saw some old ice—I should not think would be more than five or six years old, at all events.

The ice we saw was on an average, I should say, about 10 to 12 feet thick, and I don't believe that polar ice in the open sea will, as a rule, freeze much thicker. I paid much attention to the thickness of the ice at various seasons of the year. The ice formed in October and November, 1893, had next spring, in April, 1894, reached the thickness of $7\frac{1}{2}$ feet, but it continued to increase steadily during the summer, and on June 9 it had reached the thickness of 8 feet 3 inches; and this in spite of the fact that the ice was now melted on the surface by the rays of the sun. On June 20 the thickness was still the same; the thaw on the surface was considerable, and there were large fresh-water pools in every direction, but the ice was being constantly formed on the under side in spite of this. The rest of June the ice continued about the same, until about July 10 it suddenly received a new layer underneath and became 9 feet thick. This increase I understood to be owing to the layer of fresh water which during the summer was swimming on the cold salt water underneath; at the depth where this fresh water touched the very cold salt water there was therefore formed a thick layer of fresh ice. This made the floe-ice considerably thicker. However, as the autumn approached the ice would decrease in thickness, but next winter it would continue to grow again slowly. On December 11 the thickness was 7 feet; on February 6, 1895, the thickness was 8 feet 4 inches. During the spring it went on growing, and on May 11, 1895, it had grown to 9 feet 10 inches, and it was about the same at the end of May. This was the thickness of the ice arrived at during more than one and a half year. We made some other measurements. The greatest thickness that we found the ice actually reached by freezing without being piled up was 13 feet 10 inches; this was in May, 1896, and probably after four years' drift in the sea. I think it may be that ice stopped by land and kept there for years might form thicker, but the warm water underneath would prevent the growing of ice to a certain extent. When it has reached a certain depth, it cannot form any thicker. There is sufficient heat

to prevent the formation of ice on the under side, but by the piling up of the ice much thicker floes will of course be formed.

I mentioned the water temperatures; I think they are also interesting, and will give you a few taken at various depths. Excepting the sea near the coast of Siberia, where of course the conditions are altered on account of the shallow water and the currents running along the coast, we find almost everywhere the conditions of the temperature pretty constant, almost the same month after month and year after year. Of course there were variations, but so small that they are not of sufficient importance to be mentioned here. I will take one series of temperatures obtained in August, 1894.* Now, measuring by Centigrade thermometer, it would be on the surface 1·9 above, but at 2 metres' depth the temperature sank down to −1·3, very near the freezing-point of the salt water; at 20 metres it was the same as at 40 metres, −1·5, about the freezing-point of salt water with that salinity. The same temperature is found down to 100 metres, where it begins slowly to rise again, and is −1·4. Then it would rise slowly downwards; at 140 metres it was about −1 below freezing; at 200 metres it would be −0·03; then at 220 metres it rose above freezing-point, +0·19. Deeper the temperatures did not alter quite regularly, sometimes lower, sometimes higher again, showing that the currents must be running underneath. At 280 metres it was 0·4 above, and 300 metres 0·3, consequently lower again; at 350 metres it would again rise to 0·4, and then it would go on above freezing-point until 800 metres was reached, where 0·07 above freezing was registered. Then it gradually sank; at 1000 metres it was 0·1, and at 2000 metres it would be −0·6; at 3000 metres it would be −0·7. It sinks very slowly, but never reaches the freezing-point of salt water. When approaching the bottom it slowly rises again; at 3000 metres, 0·73; at 3400 metres it would be −0·69; at 3700 metres, 0·65; at 3800 metres, −0·64; the bottom was about 3850 metres deep. The main features found everywhere were, on the top a cold layer of water about 200 metres in thickness, or 100 fathoms; then the temperature of the water rose above freezing-point, and kept that down to 900 metres, or 500 fathoms; then it began to sink, and rose again when it touched the bottom. This same feature was repeated time after time, and the temperature in various months was so nearly the same, that it did not differ more than some few hundredths of a degree. This relatively warm water must be Atlantic water that runs into the polar sea as warm surface currents, branches of the Gulf Stream running northward along the west coast of Spitsbergen and eastwards to the north of Novaya Zembla. I believe that they run into the polar basin and fill the whole depth with this comparatively warm salt water, whilst the surface of the polar sea is formed by colder water with

* See table, p. 499.

less salinity, which is, of course, produced by the rivers that run into the polar basin, especially from Siberia.

I think these were, perhaps, the most important geographical and oceanographical results of the expedition. The drift of the ice, as you will have gathered from what I said in the Albert Hall, was mostly produced by the winds. The prevailing winds will produce a drift, or a current of ice if you will call it so. I dare not say yet whether there were other currents underneath. We have to work out the average directions and speed of the wind, and then work out the various observations as to the currents made by the help of constructions we sunk down into the water, before anything can be said with certainty on this subject.

The best period for our drift was winter and spring, and the worst period would be, as a rule, the summer and the beginning of the autumn. During that time we were stopped or drifted backwards; with the late autumn we drifted on again, and during the winter, as a rule, we had a fairly good drift, except during the last spring, when the *Fram* was stopped by southerly winds, until she at last got favourable winds and drifted on again. I quite agree with the President, that what now ought to be done in the arctic regions is especially the exploration of that part of the polar area to the north of the North American Archipelago and the north part of Greenland; but, as the President said, I think also that the same principle we made use of, to drift with the ice, ought to be tried once more. I think, if the expedition were as well prepared as we were, and went north through Bering straits, not so much to the west as the *Jeannette*, you would get another drift straight across the polar region, and that would probably last five years, and during these five years there would be excellent opportunities to take scientific observations of all kinds. I think what we really want is scientific observations from the arctic regions. Of course, in a shorter expedition with sledges some explorations can be done, and I do not think it is difficult to reach the pole in this way. If you care for it, you can easily do it with dogs; it is only a question of dogs. I am doubtful, however, whether it is worth while. You do not bring back sufficient observations to pay for the waste of time and labour; but we want scientific observations, and to get these, I can assure you there is not a better plan than that on which we worked—to go with the ship into the ice. It will give you the most excellent observatory you can wish for; you can have all kinds of laboratories on board, even much better arranged than they were on board the *Fram*, and if a man would spend five years over it, he would bring back observations that would pay him many times; he would then have rich material with which to form a clear and adequate idea of the physical conditions in the north polar region, and that is what we want.

The PRESIDENT: We have the great pleasure of welcoming Sir Joseph Hooker here this evening, and as he is a veteran who was studying

polar subjects and battling with polar ice thirty years before Dr. Nansen was born, I venture to request him to continue the discussion.

Sir JOSEPH HOOKER: It would give me very great pleasure if I could say anything that would throw any light upon this discussion. I certainly should have thought myself the last person to be called upon so early to speak on the subject. Of course my speciality is botany, and you would expect to hear from me something connected with the flora of these lands and countries, and how far the further exploration which your President supports is likely to throw any light on that branch of science. Now, I must confess I am in some difficulty, because the interest of botany in these regions is comparatively scanty; it is, however, threefold. In the first place, there is the existing flora, the flowering plants with which we are most familiar. Now, I don't think further exploration of the polar region will add much to our knowledge of that branch of botany. We pretty well know what the plants are, and don't expect any addition to our knowledge in that respect, nor their geographical distribution. It is further established that the arctic flora is divided under three groups—Asiatic, European, and American—that are slightly different from one another. These groups have been pointed out and pretty well limited in each direction. We don't expect the individual species to extend much further north than they have been found to do, and if they do, it can only be in respect of a very few species; and as we advance further into the polar area, we find ourselves in the position of the poor professor who had to lecture on the snakes of a certain island, and commenced his lecture by saying, "There are no snakes on this island." The two other divisions are of vast interest and great importance. One of these is the fossil flora. We know from repeated observations that, as your President pointed out, large floras are locked up in the geological formations of high northern regions. They occur in Skye, where fossil leaves are found in beds of trap. They are found in abundance in Greenland, and again in Spitsbergen. Now, that is a botanical subject of the greatest difficulty, because the plants occur only in a fragmentary condition, and it requires great skill and knowledge and a number of specimens to exactly ascertain what they are. What they have certainly proved is, that they are indications of a warm temperature having prevailed over these regions. Now, a further exploration may lead us to hope that more land will be found in the polar area in which these plants may be embedded, and which would therefore give us a vast extension of our knowledge of what the flora must have been in former days, and an increased number of specimens to certify the knowledge we have already.

The third point to which I have to draw your attention is the existence of that microscopic flora and microscopic fauna that swarm in the polar sea; of those plants especially which, being coated with silica, are absolutely indestructible, and, falling to the bottom of the sea,

form vast beds of what is practically Tripoli stone. Now, I am not aware of any beds of that description being found in the northern seas, but in the southern they extend along the shores of Victoria Land at a depth of 200 fathoms, as beds of silicious mud capable under pressure of forming Tripoli stone. Beyond this I don't think I have anything further to say, but may touch on one subject, which is a difficult one. I should like to know whether any observations were made during the expedition of the *Fram* on evaporation from the ice, and on the extent of loss by such evaporation. We have been told that where large masses of snow accumulate, they are carried off by floes in one case into warmer waters, and in the other in the form of glaciers. I have been led to doubt whether these sources account for the enormous waste of ice that goes on in the polar regions, and should be glad to know whether any observations of this subject were made by Professor Nansen.

The PRESIDENT: I don't know that any one can impress upon us the practical value of polar research better than Prof. Rücker, with regard to magnetic observations.

Prof. RÜCKER: I hardly expected to be called upon so early in the evening, because, although not wholly a laboratory worker, I have had no personal experience of expeditions which can be compared with that which has been described by Dr. Nansen; but, at the same time, there can be no doubt that the interest of this expedition very largely centres about the magnetic work done, and I hope, when the various observations of Dr. Nansen and his friends have been worked out, something of interest may be added to our knowledge of magnetism. Perhaps it would be well to preface these remarks by a word or two on observations of this sort. There is no doubt that the whole subject is one of the most mysterious with which science has to deal, and we have at present very little knowledge as to the cause of the phenomena we observe. The time is now coming when the facts will be regarded from a wider point of view than that adopted a few years ago.

We now have sufficient knowledge of the magnetic state of the Earth to be able to draw fairly accurate magnetic maps, and, by the methods originally devised by the mathematician, Gauss, to get some idea of the magnetic state of the world as a whole. Instead of concentrating attention upon the more or less fictitious poles which the magneticians of the past were so fond of, an attempt is now being made to break up the forces into various groups, and to separate the great group of forces which represent the Earth's magnetism parallel to one axis, from others which may perhaps represent the disturbing influences. Then follows one of the most interesting questions which next century will solve. Is it possible that these groups of forces represent those portions of the magnetism of the Earth which are respectively at rest and stationary? to picture the state of the Earth as partly due to permanent magnetism,

and partly to superimposed and moving magnetism which disturbs the simple results due to the first cause? If this were possible, if we could represent the Earth so, then a very great step would be made in the theory of terrestrial magnetism. It is to further observation that we must look for a solution of this problem, and, in order to solve it quickly, it is necessary that these observations should be well distributed over the Earth.

Dr. Nansen's expedition will, no doubt, have done a great deal in adding to our knowledge of the magnetic state of the north polar area, but one point has not been referred to which leads us to hope that the observations may be of a very high order of accuracy indeed. The land often produces a very great effect upon the needle, but Dr. Nansen's observations have been made, not only on non-magnetic ice, but on a vast depth of non-magnetic water, and therefore the disturbing causes which are so troublesome on land will be absent. Turning next to the meteorological conditions under which the observations were made, I can only say that I have myself made many magnetic observations under the comparatively small variations of temperature which we suffer from or enjoy, the heat of summer and the cold of winter. I know what the difficulties are, and I am overwhelmed with astonishment as to how such observations were made by polar explorers at all.

There is one point more to which I wish to refer. It is extremely desirable that the work done so well in the north should be carried out in the south. Some eighteen months or two years ago, a strong committee was appointed by the Royal Society, to wait upon the then Government, asking them to do something to help forward an antarctic expedition. The magnetical reasons for such an expedition were then fully explained, and I don't know that, in the comparatively small interval of time that has elapsed, there is much to add to them. I may, however, just refer to the main point. As every member of the Geographical Society knows, a vast portion of the southern hemisphere is covered with water. There are only two or three great projections of land running into it. At these points we know something of the magnetic state of the Earth, but of the intervening regions of the sea we know comparatively little, and it is essential, if we are to master the problem of the Earth's magnetism, that our knowledge should be increased. I therefore can only say, from the point of view of the science of magnetism, we want especially observations in the southern hemisphere, and I only hope the great impetus given by Dr. Nansen to polar exploration may, by some sort of resonant vibration, spread from the north to the south.

Prof. JUDD: It may appear at first sight that Dr. Nansen has brought back a message which will be very disappointing to geologists, when he tells us that in that great area there is practically no land, and that there is no hope for the geologists to learn anything new in their

particular domain. But I need not point out that there are many facts that may be obtained by polar, and even by north polar, exploration which will be of great interest to geologists, such as the nature of the bottom of the sea in that area; and we must all sympathize and rejoice with Dr. Nansen, that although no special provisions were made for deep-sea soundings, yet, with that wonderful ingenuity so largely the secret of his success, he managed to extemporize a line and obtain soundings that have been of such great value. Nevertheless, with proper appliances I doubt not we should obtain many samples of the bottom of this great ocean, and, more than that, it is possible that even dredging might be accomplished with proper appliances. But, taking the land which has been visited, it is far from devoid of interest. Sir Joseph Hooker has pointed out the wonderful character of the ancient flora found in the arctic regions, now carried to a much more northern point by these researches of Dr. Nansen; but I would remind you that those remarkable beds of Jurassic rocks, which contain the flora in question, are associated with volcanic rocks of great interest. Many geologists have had to regret the loss of specimens, but few have had to assign for their loss such a cause as that which deprives us of Dr. Nansen's specimens—their having been stolen by foxes. There is no doubt that the nature of these volcanic rocks is worth careful consideration. We are inclined to ascribe volcanic rocks to the same age as the stratified rocks with which they are associated; and, without denying that the whole of these volcanic rocks may be of Jurassic age, I would remind you that our own volcanic rocks, now known to be Tertiary, were long supposed to be Jurassic, because they were intruded into rocks containing Jurassic fossils. It is possible that part, if not the whole, of these rocks may really be of different age from the beds with which they happen to be associated. It may be that the basalts and other rocks found in the west of Scotland, and reaching away through Iceland to Greenland, may be found in the lands visited by Dr. Nansen, associated with an older series of volcanic rocks. There are many problems for a solution of which we must look to the new expedition we have almost had promised us to-night by Dr. Nansen, an expedition which, traversing the Arctic Ocean at a higher latitude, may bring us news of other new and interesting lands.

Dr. JOHN MURRAY: The President and Dr. Nansen referred to the depth of the polar basin and the temperature of the deep water as among the most interesting results of the expedition of the *Fram*. I cannot say that the results, so far as at present made known, are in any way unexpected, either with reference to the depth or the temperature of the deep water. The observations in this unknown region are of the very greatest importance, and we look forward to the publication of details with great interest; but, so far as we can at present judge, the results are precisely what oceanographers would have expected. In

the first deep-sea investigations, Thomson and Carpenter pointed out, to the north of Scotland, two areas at the bottom of the sea in which the temperature of the water at depths of half a mile differed as much as 10° or 12° C. These areas were not distant from each other more than 10 or 15 miles. The fauna in the two areas differed from each other as widely as the temperatures. It was believed that these waters of different temperatures existed at the bottom without any intervening barrier. After the return of the *Challenger* Expedition this area was again examined by the *Triton* and *Knight Errant* expeditions, and a ridge was found stretching between the north of Scotland and the Færoe islands, with an averge depth on it of 250 fathoms, separating the cold from the warm water. On the north side of this ridge ice-cold water is found at a depth of 250 fathoms, and water of −1° C. at a depth of 300 fathoms. But the Norwegian North Atlantic expedition has shown that these temperatures are found at a much greater depth along the western coasts of Norway. At the arctic circle the isotherm of 0° C. lies in the eastern part of the Norwegian sea at a depth of 400 fathoms, and the isotherm of −1° C. at a depth of 900 fathoms. At the latitude of 70° the isotherm of 0° C. lies at a depth of 660 fathoms, and the isotherm of −1° C. at a depth of 1100 fathoms. This is evidently due to the warm and salt water from the Atlantic sinking towards the bottom as it reaches higher latitudes. I should not expect a very cold temperature at the bottom in the region traversed by the *Fram*. At a latitude of 80° to the north of Spitsbergen, the highest temperature of the sea-water (3° C.) occurs at a depth of 100 fathoms beneath the surface, and it is evidently this water which sinks in the polar area and gives the relatively warm water reported by the *Fram*. In the western parts of the Norwegian sea we find a condition of matters much the same as the *Challenger* found at the antarctic, viz. cold fresh water on the surface overlaying dense and warm water at a depth of 100 and 200 fathoms. From these considerations, those engaged in working out the *Challenger* observations have long been convinced that there was deep water towards the pole, and in my papers the depth of the polar basin has always been taken as not less than 1500 fathoms. It must be remembered that the range of temperature reported by the *Fram* rarely exceeds a degree and a half in the deep water. The observations of the *Fram* have confirmed the theoretical views of oceanographers, and cannot be said to have been in any way unexpected. It is, however, a very great thing to have made direct observations in this almost inaccessible region. Dr. Nansen has cut out of the unknown a great region, and has placed it well within the known.

Dr. Bowdler Sharpe: I am sorry to say that, in the course of my studies of birds at the British Museum, and in the different volumes of the Catalogue I have had to write, it has not fallen to my lot to work out many of the birds of the arctic regions, and I am not perfectly

learned on that subject; still, I take it that the compliment paid me by the President, in calling on me to speak, means that perhaps the audience would like to know what ornithologists think of Dr. Nansen's voyage. We have heard, and every one confirms it, that in every branch of science his results have been of the greatest importance. So far the poor man has not had a moment to give us the results of his biological observations; but, from what we know of him, we are certain that what there was to be done was done, and that his discoveries will be placed before us in due time. Still, the interest of research in the arctic regions, as regards birds, always sums itself up into one or two directions to the explorer: "Be sure to find the egg of the Knot, or Curlew-Sandpiper, or find out Ross's Gull—tell us where it breeds." Dr. Nansen found Ross's Gull breeding, and that is all ornithologists can ask of an arctic explorer, that he solves one or two of these questions, and as Dr. Nansen has done that, I am sure his minor observations will also be of importance. Perhaps the audience may not know what Ross's Gull is. It is a very beautiful little Gull, with a hood and a wedge-shaped tail, and is called the wedge-tailed Gull. One of the specimens so called after the gallant commander occurred, or is said to have occurred, in Yorkshire, and two specimens in breeding plumage have been found off the coast of Greenland, and one of these was purchased by your late secretary, Henry Seebohm, and presented to the National Museum, where we have regarded it as one of our greatest treasures. There are not many specimens in museums, certainly not in breeding plumage. A number of specimens were got by the American expedition to Point Barrow; they were all young birds, and were seen only in September and October, travelling in flocks from south-west to north-east. But the breeding-place was entirely unknown, and therefore I should like to join my voice in congratulating Dr. Nansen on having solved one question of the few we set him to do when he went on his expedition.

Colonel FEILDEN: When our President advances the view that "the great polar sea is probably a sea without islands, and if so it is a sea of solitude," I would venture to point out certain facts which may throw a ray of light on this problem. The late Dr. Bessels of the *Polaris* expedition was the first to recognize and to record the number of foreign boulders scattered over North Greenland, in the vicinity of Thank God harbour, from the present shore-line to altitudes of 1000 feet. He remarked upon their absolute dissimilarity with the rock *in situ*, and, struck by a peculiar rock predominant amongst these erratic boulders, which he thought was precisely similar to a rock found *in situ* in South Greenland, came to the startling conclusion that when these erratics were deposited from their ice-rafts, the set of the current had been from the southward, up Smith sound, and into the polar basin. A more erroneous deduction could

not have been arrived at. Following in the footsteps of Bessels, and with the advantage of his experience—for he was a man of great scientific attainments — and fortunately having had much greater opportunities of geological investigation in that area, I satisfactorily determined that the present direction of the Smith sound current had not altered, certainly not for a long period of geological time.

The glacio-marine deposits so widely distributed over Grinnell Land and North Greenland testify to the fact that the currents and conditions under which these beds were laid down, from elevations of 1000 feet above the sea to the present-shore line, have been precisely similar. At every elevation we find the same coniferous wood from the great rivers of Siberia, the remains of the same fauna, and the same character of ice-borne erratic boulders. These erratics are of diverse lithological structure, but there is a widely distributed erratic amongst them, so marked in its composition, that I have little doubt it is the one that induced Bessels to formulate his theory of change in the present set of the currents in Smith sound. The rock I refer to is a peculiar gneissoid rock largely composed of garnet. Its structure is described in the *Geological Magazine* for 1895. This rock does not appear *in situ* on the American or Greenland shores that have been visited, from Capes Alexander and Isabella to Robeson's channel, and certainly not from Cape Union or Thank God harbour to Aldrich's Farthest on Grinnell Land, or to Lockwood's Farthest. From whence, then, are these erratics derived? Not from Siberia, I think; not from the New Siberian islands nor Bennet island. For it is noteworthy that of the many boulders examined in Grinnell Land, there was not one, I believe, identical in character with the known rocks *in situ* on the Asiatic side of the polar basin. Satisfied that the ice-transported erratics now resting on the shores of Grinnell Land and North Greenland facing the pole are not derived from the southward, and not from the continent of Asia nor the islands lying north of that continent, I think it not improbable that there may be some land or islands within the unknown area of the polar region from whence these erratics have been brought, and are still being stranded on the shores of Grinnell Land and North Greenland.

Sir Leopold McClintock: I beg to thank the President for his kindness in inviting me to speak. I have no doubt he expected me to say something interesting, but I am not going to say anything scientific; I will only remind you that I have had a great deal of experience of work in the arctic regions of the New World—something like ten years—and I have sledged over the ice-surface for 4000 miles; but I will only make one observation to you, which is to point out the strong dissimilarity of the ice north of the American continent from that which Dr. Nansen found on the Siberian shores. In all these long sledgings and years of experience

and exploration, I never found any of these open lanes in the ice. We never found any cracks which we could not jump over: so utterly distinct was our ice from what Dr. Nansen experienced. We carried no boats; we did not want them; there was no current to set this polar pack in motion. There it remained outside the Parry islands, locked up by land, year after year until it attained enormous thickness. I think Lieut. Mecham, when sledging along the west coast of Prince Patrick island, in May, 1853, speaks of immense ranges of ice piled high up, from being forced in upon the shore, and showing a thickness of ice not less than 50 feet. It must have taken a long time for the floe to obtain such thickness as that. I only dwell upon these facts to show how different the two sides of the polar hemisphere can be, and that our experience in the Franklin search throws no light at all upon what Dr. Nansen has so clearly described to us to-night. I will not take up your time any longer, except to remark that the cause of this immense difference in the thickness of the ice encountered is worthy of investigation.

Sir GEORGE NARES: What we have learnt from Dr. Nansen's expedition is that there is evidently a dividing-line across the polar area, say somewhere from Bering strait across to Lockwood's Farthest north of Greenland, where you will find this heavy, or, as we called it in the *Alert* and *Discovery* Expedition, palæocrystic ice on the American side, and the lighter ice on the Asiatic coast. We knew before Nansen's expedition that along the Siberian coast there was young ice, *i.e.* one year's ice. We put it down to the warm water discharged from the enormous Siberian rivers, which so largely exceed the discharge from the American side; but it is quite news to us now that this young ice two or three years old extends all the way to where we knew there was a current always running out of the polar seas. Nansen's voyage, in conjunction with the *Jeannette* drift from Bering strait to the Siberian islands, shows that all that drift is purely a wind drift. It was slow, but in a direction away from the land towards the northward and westward. Still it cannot be depended upon, and I think Dr. Nansen was very fortunate in his first year in getting away from that land, where we expected his difficulties would be. Once well away, we knew he would come across if his ship could keep up. As to this dividing-line, there is the question as to the thickness of the ice on the American side, and as to where it is derived from, and whether that line is straight from Bering strait or curved. There is no doubt that all along this coast the ice which we found north of Melville island and at Patrick's island is sea-ice. Now, Nansen tells us that in one year he measured 7 or 8 feet of ice, practically the same as our old measurements in other regions; he gives us in two years 13 feet of ice that was solidly frozen ice without any rise of one floe over another. Very well; now if you annually get floes of that kind nipped together, you will soon get ice of extreme thickness. Sir

Joseph Hooker put an important question about evaporation. Well, off the *Alert's* winter quarters the evaporation far exceeded the precipitation; but then, of course, you won't find the same balance all over the polar region; we were beyond the area of precipitation, and experienced very little snowfall. Further south it would be different, but at the border of the arctic sea evaporation far exceeds precipitation, therefore in the summer there is the constant melting down of the blocks on the top level of the floe, and consolidating into a regular massive piece of ice. Our measurements were over 100 feet thick, and there is no doubt, as Colonel Feilden says, there was no idea of this being formed anywhere except at sea. Of course, there is melted snow mixed with the salt-water formed ice, but there is no doubt that they were really floe-bergs. I won't enter into the question of land; I am rather inclined to go against Colonel Feilden and join with Nansen that there cannot be large lands. There may be some small islands, but certainly it has ceased to be now an important question to us. Nansen's journey over the ice of course enabled him to explore a much larger area than the friends he left on board the *Fram*. They were frozen up in their surroundings and drifted on, and it is a most remarkable thing to us—I join several arctics with me—the enormous quantity of ice all through this region of practically less than one year's growth. He comes across ice over and and over again that has only been formed a few months. What I am aiming at is to put before you that his voyage is in no way an exceptional one. There is evidently this continuous drift through the polar region, and the enormous quantity of young ice met with proves that it can have been in no way an exceptional season. Now we are talking about another expedition, perhaps starting from the American side of Bering strait. I will only make one remark—that is, we must dwell upon the large number of American whalers that have been lost in the ice just in that spot north of Cape Barrow, and never been traced or heard of. There must be something different in the winds there, not blowing the ice off to get away from the land into the southerly current, totally different to that met with on the other side. As an interesting remark, talking about the palæocrystic ice, there is no doubt that there are few outlets through which it can come. We found it drifting through Robeson channel; it also is met with in the *cul-de-sac* south-eastward of McClintock channel, where it undoubtedly stopped Franklin from making the north-west passage.

As far as geographical questions go, I think I should like to have had this discussion a few months later. We have not had time to properly dwell on the large results of the Nansen Expedition; we have scarcely had time to read his interesting book; but the meteorological questions alone, in conjunction with those of the Jackson-Harmsworth Expedition for three years, will certainly enlighten us very greatly when

we can put them together. The question of the temperature of the sea was what I had a great deal to do with in the *Challenger*. We found very much the same tongues of cold and warm water in the antarctic region. But I should like to know by-and-by, when Dr. Nansen's results have been thoroughly worked out, how he explains finding warm water down at the bottom: it is most interesting, and found nowhere else in the world.

Dr. NANSEN: I will try to answer the various questions that have been put, and will do so as briefly as possible. Sir Joseph Hooker asked about diatoms in the north: I think in this respect the expedition has brought back some interesting results, as I discovered a whole new world of diatoms living on the surface of the polar ice in the fresh-water ponds found on the surface of the floes through the short summer in the north. I discovered some brown, yellow, or red-brown spots as soon as the ponds were formed. I thought it was mud, but by taking a little of this mud and placing it under a microscope, I discovered it was swarming with diatoms, and amongst them I found small animals feeding on them. As time went on I saw these small patches growing and forming holes in the ice, and thus a whole flora of diatoms was living on the ice, freezing up every winter and reviving again for the summer. I regret I cannot say anything about them to-day, because that is material which has to be worked out by a specialist, but I dare say there are many new and interesting forms amongst them. I also found a good many small infusoria. Unfortunately, I had not much literature with me to help me in these my investigations; but I brought material back, and I hope in this respect to get some results. On the whole we thus see that on the surface of the floe ice, constantly travelling across the polar region, there is a fauna and flora living every summer and freezing up in the ice every winter, and I dare say some of these diatoms may be the same as those found by the Nares Expedition in the ice north of Grinnell Land. In connection with this, I may also remind you that one of my evidences before I sailed, which I believed proved a current running across the polar region, was the mud I found on the drift-ice along the east coast of Greenland; in this mud diatoms were discovered which were only found once before in the whole world, and that was at a cape a little north-west of Bering strait. It may be that many of these diatoms found during this expedition will be the same species and of the same sort.

As to deposits of diatoms on the bottom, I believe our results are in the negative as far as my investigations go. In the samples of mud from the bottom of the polar sea I found but little organic life; the mud seems mostly to consist of mineral substances, and there was even very little chalk or anything of that kind to be discovered in it. Sir Joseph Hooker asked me one question as to the evaporation from the ice. I could not make any direct investigations on the subject, but from what

little I could make out, I got the impression that evaporation was considerably less than the precipitation. The whole winter there was a good deal of condensation of moisture going on on the surface; it was constantly covered with hoar-frost, and we made some attempts to determine the amount formed from day to day: it was considerable. I have not the material here to-night, so I cannot tell you more about it. I must say that my impression is that during the winter there is very little evaporation from the surface, but a good deal of condensation of moisture on the polar ice. Sir George Nares seemed to be of the opposite opinion. But there is one thing that struck me: if the palæocrystic ice is sea-ice, and the layers are consolidated by precipitation every year, then I believe this proves that the evaporation cannot exceed the precipitation; for if such was the case, I do not understand how the layers could be formed.

Prof. Rücker asked about our magnetic observations. I am sorry to say I cannot give much information about that here to-night, as that was not my line. Lieut. Scott Hansen had to take care of these observations, and as I had much to do with my own investigations, I had little time to spend over his, but I believe that they will throw some light on the problems mentioned by Prof. Rücker. I believe that the observations are exceedingly carefully done, and I can only say that, from what I saw of Scott Hansen's method of working, he was a constant object of my admiration. He carried on his observations with never-failing care at any temperature, even at 60° below zero, and came in with his nose or fingers frozen, and would not admit that it was cold outside. From what little I can gather from these observations, we found the inclination and declination pretty much what you would expect. Neumayer had already, before we went out, given us some data as he thought we should find them, and we actually found much the same as he had expected; but I believe the inclination, so far as I remember about 87° at the furthest north, was little more than was expected. There was one thing that made observations at times a little difficult: the disturbances of the needle were often very great, owing to the northern lights. I believe on one occasion we had disturbances about 24°, and that is, as far as I understand, unusually much.

Prof. Judd asked me a question about the geological results, and he spoke about the deposits in the arctic sea. I have already said something about it. I hope the samples will throw some light upon the deposits, though, of course, a new expedition, well equipped with deep-sea sounding apparatus, would bring back better samples. I believe these deposits will prove to be extremely devoid of organic matter, and will mostly consist of mineral substances. He said he thought it might be that the basalts of Franz Josef Land are Tertiary. I cannot deny it; only one thing makes me think they are Jurassic rocks, and

that is, that they rest on a bed of clay reaching from the level of the sea up to 500 feet above it. This is Jurassic (Russian Jura). Immediately on this clay rose the basalt, and on the top of the basalt I found in one place, with Jackson and Koetlitz, plants and fossils, which have been examined, and are found to be of late Jurassic age. The flora is mostly coniferous, and seems, as Prof. Nathorst says, to point to a not very warm climate, though naturally much more favourable than the climate in these regions to-day. This is one reason why I and Prof. Brögger, who have examined these basalts—although there has not been time for exact investigation—came to the conclusion that they were of Mesozoic origin. One circumstance that might also point in the same direction: the rocks are different from the basalts of Scotland, the Færoes, and Iceland; there is extraordinarily little olivine iron ore. They seem to resemble some basalts which are known from Spitsbergen, and Prof. Brögger believes that these belong to one area of eruption. I therefore believe that we must consider Franz Josef Land and Spitsbergen as belonging to the same group of islands; also that in the still unknown distance between them we will find a series of islands, mostly of volcanic nature.

I will only make a few more remarks as to Mr. Sharpe's question about the ornithological results. He asked where we found Ross's gull breeding, and I pointed to a place on the north-east side of Franz Josef Land. They were in the first islands we met with. I must, however, point out that I did not actually see birds breeding. I got the impression they must breed there because I saw old birds and young birds together the same year, and there were so many of them. I could not easily imagine they had come from a land far off, as I did not know of any such land. They were just in the neighbourhood of these islands, and as soon as we went away we did not see them any more. On the spot where we spent our last winter we did not see a single Ross's gull, while on these islands, not many miles to the north-east, it was a quite common bird—almost as common as the ivory gull and the kittiwake; that was the reason that led me to believe that the Ross's gull was actually breeding there. It may breed on the rocks on the beach, like the ivory gull, or perhaps on the ice; nobody knows. Of course it is not probable that they should breed on the ice; still, on these islands there were but few rocks. As the President remarked, we saw little auks in the north, but we saw more dovekies. As far north as we went in the *Fram*, we saw birds in the summer-time. It is extraordinary how far birds will fly away from land. In June and July, 1895, to the north of Franz Josef Land, we could see flocks of little auks and dovekies coming from the south, and then returning to the south again. We understood that these birds came from some land, and wished we could follow them; but we had to travel for weeks and weeks before we came to that land, which they probably reached in a few hours: and when

settled for the winter in Franz Josef Land, we saw in the spring the birds (little auks and dovekies) steer away out to sea; we could see no water, but they went straight out, and returned after twenty-four hours. The birds we saw on board the *Fram* were mostly ivory gulls and other gulls, dovekies, kittiwakes, Ross's gulls, mallemocks, scures, and a few little auks. These birds do not prove that there was any land in the neighbourhood, as I think they may be expected wherever there are water-lanes, because there they find plenty of food—small crustaceans; the birds we shot were always full of shrimps and small crustaceans. I believe these birds fly across the polar sea anywhere.

The circumstances to which Colonel Feilden drew attention in connection with my doubt about the palæocrystic ice, that there are diatoms in the layers of dust, is interesting, and, face to face with such a fact, I will give in and say I believe that the ice must be of oceanic origin. As to Colonel Feilden's belief in a land to the north on account of certain erratic blocks found on the shores of Grinnell Land and North Greenland, I will just put one question. Why could not these come from the interior of Greenland? May there not be far away under the glacier cover, rocks of the same description? and then I don't see any reason why blocks from them should not be carried to the coast by the glaciers. So long as we don't know the rocks in the interior of Greenland, I think the most natural explanation must be that these erratic blocks have come from that direction. I will just close with a few remarks on the interesting statement made by Sir George Nares about the palæocrystic ice. Now, in my opinion this ice is one of the most interesting problems in the polar region, a problem which I should like to see solved as soon as possible. I think we have here something quite different from the ice we have seen. If this palæocrystic ice really is oceanic, it must, of course, be very old, and I think it could only reach that thickness in the neighbourhood of land. My opinion is that this ice must be formed near the American side where the drift is stopped by the islands, where the pressure is tremendous, and the floes are piled up and frozen together, snow covered, and levelled up. I don't think ice of 50 feet thickness can easily be formed in the open sea, because I believe the loss of heat by radiation from the surface would not penetrate sufficiently quick to such a depth, and when the ice reaches a certain thickness, it cannot, therefore, easily grow much thicker by direct freezing. I believe this extraordinarily thick ice will only be found quite near the lands on the American side, and when we come a little further north we will find thinner ice more like the ice we found, and which has more motion than that across which Albert Markham travelled on his wonderful journey.

I said before I should like to see an expedition start from the sea north of the Bering strait, in the same way as we did. I know, as

Nares said, that many American whalers have been lost there, and have been drifted northwards and disappeared; but that is just one reason more why I should like to see an expedition start from that side. These whalers are not specially built to stand any pressure of ice; they are built to hold a big cargo, and they pay extraordinary little attention to the strength of the ship. If you build a ship like the *Fram*, and go north there, I think that is the best way of solving what is perhaps the most important problem left in the north polar region.

The PRESIDENT: It remains for me to propose to the meeting a vote of thanks to Dr. Nansen for the extremely interesting discourse he addressed to us at the commencement of this discussion, and for the great care he has taken in noting the remarks made by the various speakers, and in replying to the questions put by them.

The thanks of the meeting are also due to the distinguished scientific men and arctic officers who have joined in the discussion.

THE MESOPOTAMIAN PETROLEUM FIELD.*

By Captain F. R. MAUNSELL, R.A.

THE existence of a petroleum-bearing belt of country on the north-east of the lower Tigris valley has been noticed by various travellers, the most recent being M. de Morgan in his 'Mission Scientifique en Perse,' who deals with the naphtha pits near Kasr-i-Shirin and Shuster, so far as came within the scope of his travels. He has gone very thoroughly into the geological formation of the country near these deposits, and infers† that the pits at Kasr-i-Shirin are part of a petroleum-bearing belt extending from Kirkuk to the north of the Pusht-i-Kuh; but if the notices of various other travellers be collated, it will be found that the prospective field of enterprise is of even greater size and commercial importance. Of the various sites of these springs, I have had opportunities myself of seeing those at Hammam Ali, El Fatha, Mendali, and Kifri, and have passed through most of the country near them. Bitumen from these pits has been utilized from the very earliest times, there being a legend that the coating of pitch used for the Ark was obtained from Hit, while from Al Hadhr came the Greek fire used with such effect against the siege implements of Severus.

Although known for so long a time, the deposits have never been satisfactorily explored, or their value tested by borings on modern

* Map, p. 588.

† 'Mission Scientifique en Perse,' vol. ii. p. 86.

scientific principles; and, except in the rude pits made by the inhabitants to collect the oil, no attempts have been made to test their commercial value. The existence of such a large number of sites in a well-defined area, and the considerable quantity of bitumen and naphtha which now comes to the surface, would suggest a large supply of oil if properly tapped, and the establishment of a commercial industry of great importance. The petroleum-bearing belt commences near Mosul, and extends south-east in a broad band skirting the base of the Kurdish and Persian frontier hills as far as Shuster. The following outline of the geological formation of the country will assist in determining the position of the belt.

North-east of Mosul, the last outliers of the great Kurdish mountains consist of a series of well-defined ridges of limestone overlooking Alkosh and Sheikh Adi, parallel to each other, and running generally north-west and south-east. Continuing to the south-east there is the long wall of limestone extending from Girdamamik, on the Great Zab, to near Keui Sanjak, on the lesser Zab river, forming the limit to the hill country. West of the Sulaimania district is the Kara Dagh, a similar rocky dividing-line extending from the lesser Zab to the Diala. On the left bank of the Diala comes a lowland basin, in which are situated Kasr-i-Shirin and Zohab. This stands at the north-western border of the many ranges comprising the Pusht-i-Kuh, and is bounded by the Sunbula Kuh, the Kuh-i-Ahengiran, and Kuh-i-Delaho, whose extremities overlook it, and the rocky ridges north-east of Zohab, which extend to the Diala. In the Pusht-i-Kuh, the parallel character of the various limestone ranges becomes even more marked, and follows the general line of the Turko-Persian frontier some 20 miles from it.

The general line of limestone ridges thus sketched out from Mosul to the Pusht-i-Kuh marks a sharp division of geological formation. Immediately to the west of them the well-defined character of the hills ceases, and a broad belt of undulating country, crossed by several small sandstone ridges, supervenes. In this formation appear many beds of gypsum, particularly noticeable on both banks of the Tigris at Mosul, where they are used for supplying building-cement, and an easily worked white and grey marble. Also near Kifri, and along the ridge to the north-west of it as far as Tuz Khurmatli, are extensive deposits of gypsum; also at Mendali and between Husseinie and Zorbatie. The Karachok and Baravan Dagh are isolated sandstone ridges rising to no great height above a general plain of conglomerate formation.

The Jebel Hamrin is a well-marked feature which commences not far north of Mendali, and extends north-west till it is lost in the plain beyond the Tigris near Kala Sherghat. It rises some 600 feet above the plain, and is mostly composed of sandstone and conglomerate. Along the western edge of the Pusht-i-kuh, following the line of the Turko-

Persian frontier, is a belt of low hills of sandstone and conglomerate formations, with occasional beds of gypsum, about 20 miles broad. The great alluvial plain of the lower Tigris and Euphrates commences below Tekrit and Hit, and extends to the Persian gulf, forming the southern limit of the petroleum-bearing belt. The most northerly deposits in the belt are at Hammam Ali, some 15 miles south of Mosul, on the right bank of the Tigris. Here are hot sulphur baths, much resorted to by the sick from Mosul, the water of which is slightly salt. There is a small basin from whence a fairly abundant supply of crude petroleum can be obtained by skimming the surface; while long threads of bitumen are constantly oozing to the surface in this and in a number of smaller pits close by, which are filled with warm water. The only buildings are the small house covering the sulphur baths and a few temporary erections close by. The whole are situated on gently rising ground about half a mile from the river-bank. The strata appear to be nearly horizontal, and the rock is a soft whitish limestone.

The next point in the belt is Al Hadhr, some 45 miles to the south-west, where naphtha pits exist in the neighbourhood. There are extensive ruins here of the ancient town of Hatræ, which do not appear to have been very recently visited by travellers, so that no detailed information regarding the pits is obtainable.

Rich * mentions naphtha pits at Kiara, on the Tigris right bank, 25 miles south of Hammam Ali, and they are probably of the same formation as at the latter place. Close to Kirkuk, in the low sandstone and conglomerate ridges near the town, are several petroleum springs, which form one of the most important commercial resources of the place. The principal caravan route from Baghdad to Mosul passes through Kifri, Kirkuk, and Erbil. A few miles south of Kifri, in the low ridge called the Jebel Oniki Imam, are naphtha pits, which are also worked, but are not so extensive as those at Kirkuk.† At Tuz Khurmatli, on the same line of hills at Kifri, are also naphtha springs, situated about 2 miles east of the place, at the foot of the Neft Dagh, or "Naphtha mountain." Gypsum is found and utilized for making cement at many points on the ridge near Kifri.

At the El Fatha defile, where the Tigris passes through the Jebel Hamrin, are extensive exudations of bitumen, and signs of the existence of petroleum. Along the left bank of the river at the defile runs a cliff 10 to 12 feet high of soft white limestone, with some conglomerate in horizontal strata. From these exude long threads of bitumen and naphtha, which pollute the river for nearly 3 miles along the bank, and there seems every promise here of satisfactory results if proper borings

* Rich's 'Residence in Kurdistan' (1836), vol. ii. p. 136.
† *Ibid.*, vol. ii. p. 277.

were carried out. Not only is the considerable extent of this site important, but as it stands on the river-bank, the oil could be at once shipped into light steamers and barges, which could navigate down to Busra, where they would meet the larger ocean-going vessels. Probably, if the line of the Jebel Hamrin to the south-east were explored, further extensions of these deposits could be found. On the right bank, some 7 miles up stream from El Fatha, is a large sulphur spring issuing from the base of a continuation of the Jebel Hamrin, which skirts the river there.

The pits at Kend-i-Shirin, over the Persian border, are exhaustively described by M. de Morgan, who gives an excellent photograph * of one of them, showing the kind of basin dug by the Kurds, to collect the naphtha. This is typical of the rude excavations made by the inhabitants at the other points in the belt.

The actual position of the pits near Mendali was not visited by me, but the Jebel Atish, or "Fire mountain," some 3 miles south of the track up the valley of the Ab-i-Gunjir, was pointed out as being the site. The exact position of the frontier-line is very indeterminate here, and is only marked in the Gunjir valley by a loose pile of stones. The country on the Persian side of the frontier is almost entirely deserted except by a few nomad Kalhur Kurds. In 1888 the pits were in working order, and the crude petroleum used to be taken to Baghdad in skins carried on camels. The pits may, therefore, be assumed to be in Turkish territory: the oil was used for lighting in Baghdad until superseded by the better refined American or Russian article. The belt of hills here intervening between the open plain on which Mendali stands, and the first ridges of limestone belonging to the Pusht-i-kuh, is of sandstone with conglomerate, of exactly the same formation as at El Fatha, and some 20 miles wide. It further extends down the whole of the frontier-line to the southern end of the Pusht-i-kuh, whence it trends off towards the Shuster and Dizful plains. There seem to be no actual naphtha pits between Mendali and Shuster; but while crossing this belt of country through Husseinie to Zorbatie, beds of gypsum were passed, with some salt springs, and a country very similar to that near Mendali was noticed.

The frontier-line of the Pusht-i-kuh is still very imperfectly explored, and some connection between the deposits near Mendali and those at Shuster may yet be found.

As regards the springs at Shuster, General Gordon states † that "American kerosene oil is being imported for lamp purposes to take the place of the Shuster crude petroleum, said to have been used there for

* 'Persia Revisited,' General Gordon (1895), p. 101.

† 'Mission Scientifique en Perse,' by de Morgan, plate xxii. vol. ii.

centuries. This petroleum contains an unusual amount of benzine, and, being highly explosive in lamps, the Shuster people, who can afford to pay for the safer substance, have taken to American oil. These oil springs may yet become the object of practical operations should the Nasiri Company develop the resources of the Karun valley."

Treating the Shuster deposits as separate from those farther north, we see that the most important section of the Mesopotamian petroleum field extends from Mosul to Mendali, a distance of 220 miles, with a breadth of about 60 miles. The Tigris navigation offers a natural outlet towards the Persian gulf, and is now regularly used for traffic all the year round between Busra and Baghdad. A line of railway from Baghdad through Kifri, Tuz Khurmatli, and Kirkuk to Mosul could bring the produce from these places to the river. If such a line were extended from Mosul to the Mediterranean, communication towards both seas would be complete. Possibly one result of the present political troubles of Turkey may be a greater facility in obtaining concessions to develop some of these remarkable mineral riches on modern lines, and, if properly explored, there is no doubt but that the Mesopotamian petroleum field might be made yield results of the greatest commercial importance.

BEAZLEY'S 'DAWN OF MODERN GEOGRAPHY.'*

Sir Edward Bunbury's great work on ancient geography, published in 1879, covered the ground from Homeric times to the age of Ptolemy. Mr. C. Raymond Beazley has set himself the task of continuing the history of geography through the Middle Ages, from Ptolemy to Prince Henry the Navigator. It is a great and difficult undertaking, but one which, if well executed, will be of the first importance to geographical students; for no such work at present exists in our literature. The first volume, which has now been received in our library, treats of the earlier and more obscure period, from A.D. 300 to A.D. 900. But Mr. Beazley promises a second volume, which will treat of the Vikings, the Crusaders, the journeys of the thirteenth-century monks and merchants to the far East, and the views respecting the sphere, of the philosophers and astronomers of the thirteenth century and of the Renaissance.

Mr. Beazley's introduction gives an interesting general review of

* 'The Dawn of Modern Geography: a History of Exploration and Geographical Science from the Conversion of the Roman Empire to A.D. 900, with an Account of the Achievements and Writings of the early Christian, Arab, and Chinese Travellers and Students.' By C. Raymond Beazley. With reproductions of the principal maps of the time. London: John Murray. 1897.

the geographical ideas, and of the travels undertaken during the Dark Ages. The first three chapters are devoted to the travels of pilgrims, of merchants, and of the Nestorian missionaries in Central Asia and China. Chapter VI. contains a detailed account of what may be called patristic geography, or science tortured into apparent harmony with revealed religion as interpreted by the monks of the Middle Ages. We are introduced to the fabulous tales of Solinus, to the portentous system of Cosmas, and to the theories of Dicuil, as well as to the less elaborate ideas of the Fathers. Here Mr. Beazley also explains the map-making of the early Christian period. The two last chapters contain excellent accounts of the Arabian geographers and their systems, and of the journeys of the Buddhist pilgrims.

This is the least promising period in the history of geography, a retrograde period, when science was thrown back for centuries by Cosmas and his like, and when the more correct learning of the ancient Greeks was despised and forgotten by Christians, and only cherished by the Arabs. Yet a knowledge of geographical history during the Dark Ages is essential, if we would fully understand the point of view of the cosmographers and explorers of the Renaissance. To furnish us with this knowledge, Mr. Beazley has spared no research and no pains. His work has two great merits: it is exhaustive as regards available authorities, and it is made interesting by judicious condensation combined with literary skill. The author has undoubtedly filled a gap in geographical literature, and in so doing he has rendered an important service to our science.

RECENT BIOGRAPHY.

The publications of the past year include the biographies of four British travellers, widely different in character and achievements, but worthy to be grouped together as alike devoted to the service of their country, and as having added, each in his own degree, to our knowledge of the Earth's surface. Travellers are so often known to the public chiefly in connection with their exploits in the field, that any fresh light on their personal life and character, and on the qualities to which they owed their success, is distinctly of value.

In writing the life of Sir John Franklin,* Mr. Traill had a difficult task to perform, both on account of the publicity which had already attached to the career of the hero, and by reason of the great mass of unpublished matter from which a limited selection has had to be made

* 'The Life of Sir John Franklin, R.N.' By H. D. Traill. With maps, portraits, and facsimiles. London: Murray. 1896.

to bring the work within the compass of a single volume. His literary skill has, however, enabled him to put together a pleasantly written and well-proportioned narrative, which makes the reader to realize, as he has perhaps never done before, Franklin's many noble qualities—his modesty, kindliness, and generosity, as well as the undaunted spirit and devotion to duty which shone out in all his actions.

Being not concerned—as was Admiral Markham's excellent summary of Franklin's arctic work—with one particular side of the hero's varied career, it of course deals more at length than the latter with other than purely geographical interests. One of the less-known chapters in Franklin's life, to which present events give a special interest, is that of his command in the Mediterranean during the troublous times following on the declaration of Greek Independence. The arctic journeys—down to their tragic yet appropriate termination in an icy grave—are clearly described, and the account of the early land expeditions, which is, perhaps, not so familiar to the present generation as it deserves to be, is specially worthy of perusal. The vividness of the story of suffering connected with the first of these is heightened by a reproduction of the scarce legible pages of the traveller's note-book, filled in by him when almost at the last extremity of starvation. The incident of an encounter with Eskimo during the second land journey exemplifies Franklin's wonderful moderation in dealing with natives, which might well serve as a pattern to some modern travellers.

In this respect the great arctic voyager finds a worthy counterpart in the late Joseph Thomson, a short but interesting account of whose life has been written by his brother.* It is matter for satisfaction that the work should have been placed in the hands of one so competent to speak of the details of his early home and college life, for with the story of his African career so fresh in the minds of the public, it is the early section of the book which presents most that will be new to the general reader. It is deeply interesting to trace, in the early life of the explorer among the simple but healthful surroundings of his father's home in Dumfriesshire, the influences which did much to fit him for his future life-work in the opening up of the Dark Continent. The romantic and imaginative element in his character, and the love of nature which led him to throw himself with characteristic enthusiasm into the study of her secrets, found full scope in the picturesque scenery of the southern Scottish hills, with their wealth of historical associations. It may not be generally known at what an early age the desire to emulate the deeds of African explorers first took root in his mind. When only eleven years old, the works of Livingstone fell into his

* 'Joseph Thomson, African Explorer: a Biography.' By his brother (Rev. J. B. Thomson, Greenock), with Contributions by friends. London: Sampson Low. 1896.

hands, arousing in him an ardent interest in the dark and mysterious lands of Central Africa, and from that day forward he maintained a fixed purpose of becoming an African explorer himself. It was this exploring instinct which led him to devote himself to the study of geology, to prosecute which he entered the university of Edinburgh. During his college days Thomson showed the fixity of purpose which in later years enabled him to overcome the many obstacles that confronted him, while his exuberant spirits and frank and kindly disposition endeared him to all with whom he came in contact. It is needless to speak of his African career, which can be followed step by step in his brother's pages, the various journeys being illustrated by a useful series of maps. From the connected view which is thus presented, the reader is enabled to realize the great influence exercised by Thomson's work on the political relations of this country with the African continent, each of the recently formed British spheres being traversed by his routes.

Our third book takes us to the more settled regions of Asia, and therefore deals less than the two former with purely geographical exploration. In his life of Brian H. Hodgson,* Sir W. Hunter gives a fascinating picture of a remarkable man, better known perhaps to a former generation than to the present, although it is scarcely three years since the veteran *savant* passed away from among us. Born in the closing year of last century, and reaching India, after a distinguished career at Haileybury, in 1818, Brian Hodgson belonged to a past race of Indian civilians, who, in the times of expansion ushered in by Lord Hastings' rule, found ample scope for the highest qualities of courage and self-reliance in the administration of newly formed provinces, far removed from the central authority. His long connection with the court of Nepal as British resident proved him eminently fitted for the task entrusted to him, and the strength and wisdom of his policy were abundantly shown by the events which followed his removal. His advocacy of the formation of Gurkha regiments may be specially mentioned as leading to the most valuable developments in our own time.

Sir W. Hunter gives us a pleasing insight into Hodgson's personal character, quoting freely from private correspondence. His goodness to his parents and other members of his family stands out in clear relief, and the long years of separation had no power to diminish the warmth of his affection. It is, however, as a scholar and scientific investigator that we are more particularly concerned with him, and the latter chapters of the book treat fully of his untiring labours in the study of nature and man in the remote regions in which his lot was cast, labours

* 'Life of Brian Houghton Hodgson.' By Sir William Wilson Hunter, K.C.S.I., M.A., LL.D. London: Murray. 1896.

which made his name known to scientific men throughout the world. Sir W. Hunter carefully analyzes Hodgson's contributions to knowledge, and shows clearly the value of his researches in the fields of ethnology and zoology, as well as his services in the more practical causes of agricultural development and vernacular education.

Limits of space forbid more than a brief reference to the life of Sir John Drummond Hay,* which has been judiciously compiled by his daughters from his own notes and memoranda. The long connection of Sir John with the court of Marocco †—from his appointment as consul-general in 1845 to his retirement from the post of minister in 1885—renders the book a valuable contribution to our knowledge of that interesting country, and it abounds, not only with vivid personal reminiscences and sporting adventures, but with details regarding the history of the country and the life of its people. During the whole period of his life in Marocco, Sir John's one aim was the upholding of British interests in the country, and his great influence with the sultan and personal hold on the people, no less than his tenacity of purpose and shrewd diplomacy, made him successful where many would have failed. The book may be recommended as presenting a life-like portrait of a devoted public servant, and one no less admirable in the more private relations of life.

DUNGENESS FORELAND.

By F. P. GULLIVER.

1. *Dissected Weald Dome.*—After the formation of the great plain extending from the structurally complicated Welsh mountains across the coastal plain of England to the simple dome of the Weald, the region was uplifted and dissected, the remnants of the plain now surviving as upland areas where the more resistant strata have longer withstood dissection. It is immaterial, for the purposes of the present article, whether one regards this plain as produced by marine denudation,‡ or considers the present adjustment of streams to structures so perfect as to demand two cycles of subaërial denudation.§ It is important, however, that the facts of planation, uplift, dissection, and final partial submergence should be clearly in mind, before one undertakes the study of the stages of development in Romney marsh or Dungeness point.

2. *English Channel.*—The borings which were made on the French and English

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* 'A Memoir of Sir John Drummond Hay, P.C., K.C.B., G.C.M.G.,' with a preface by Sir Francis W. de Winton, K.C.M.G. Portraits and illustrations. London: Murray. 1896.

† The popular form "Morocco" is retained for the name of the country, and is stated in a note on pronunciation to be undoubtedly a corruption of *Moghreb*, while "Marocco" is allowed to be derived from *Marākesh!*

‡ A. C. Ramsay, 'Phys. Geol. and Geog. of Great Britain,' 5th edit. pp. 341-346.

§ W. M. Davis, this Journal, vol. v., 1895, p. 127.

sides of the Strait of Dover, in connection with the plan for the tunnel beneath the channel, showed the rocks to be practically continuous upon the two sides. The form of the upland in north-western France also indicates that it was continuous at one time with the planed surface of the Weald dome, for at accordant elevations the nearly level surface of the chalk is continued across the anticlinal arch of the Pays de Bray. It is most probable, therefore, that after the formation of this surface of planation, which may be regarded either as an abrasion surface or as a peneplain, it was uplifted, and extended from central England to central France across the area now occupied by the Strait of Dover and the English Channel.

For the purposes of the present paper, it will be necessary to touch but lightly the most fascinating problem of the succession of forms in the history of the English Channel. It is not a typical "drowned valley." When compared with the exquisite valley-forms in south-west Ireland, which have been entered by the sea, it is seen that it is not a sufficient explanation to say that the channel is simply a subaërially carved valley depressed beneath the sea. Nevertheless, ever since Godwin-Austen studied its bed and shores, and called attention to its valley form,* it has generally been regarded as a valley formed at a time when the land stood higher. The excavation most probably has been accomplished by rivers; but the dissection was not done by one river acting during one position of the land, but by differing systems acting at different times, and possibly even flowing now east and now west.

The work of Messrs. Hébert, Dollfus, De Lapparent, Prestwich, Reid, Jukes-Browne, James Geikie, and others, has shown that a land-barrier existed from Ireland to France before the middle Eocene time; that in the middle of the Eocene, streams flowed westward into an arm of the Atlantic, aproximately where the western portion of the channel is now found; that during Miocene, Pliocene, and Pleistocene time there were many oscillations and tilts of the land, giving opportunities for subaërial dissection when the land stood relatively higher, and for marine abrasion and detrital aggradation when the sea made an ingression into the valleys; and that the present bed of the channel forms a broad plain of sand and clay surrounded, even at Jones and Little Sole banks at the western end of the channel, by a great belt of gravel and shingle.

It will be too great a digression to discuss here whether the Weald dome was breached by a branch of the Rhine running from the area of the channel toward the North Sea, or by the lower Rhine emptying into the Atlantic through the English Channel; to consider the question whether the Strait of Dover, forming such a striking contrast to the normal, systematic, and consequent streams found elsewhere upon the dome, was formed by a stream antecedent to the uplift of the arch, or by one superposed during the late stages of planation; or to discuss the probable effects of tidal action during former periods of depression of the valley of the English Channel. A geographical study of the evolution of the English Channel during the successive cycles introduced by the various elevations and depressions of the land offers an attractive subject for future field study.

3. *Initial Form of Coast.*—For this study of the stages of development of Dungeness foreland during the present cycle of coastal abrasion, it is necessary simply to accept the fact of the breach of the Weald dome by the Strait of Dover, and to concentrate attention upon the time when the sea and land took approximately their present relative positions. From the characteristic drowned valleys of the Thames, Medway, Stour, Rother, Ashburn, Ouse, etc., now filled to a greater or

* *Quart. Jour. Geol. Soc.*, vol. vi., 1849, pp. 69–97.

less extent with detritus, one must conclude that the sea at this time made an ingression upon an area of land-carved topography. The subaërially dissected land offered a new portion of its surface to the attack of the sea, and consequently the line where the waves lapped for the first time against the land at the beginning of this cycle may be called the initial shoreline. For convenience all the land back of this initial shoreline will be called the "oldland," and all alluvial accumulation built in front of the oldland in the stages of development during the progress of the cycle will be called "foreland." As the writer has already said,* the local use of the word "foreland" in the names of a few promontories—as, for example, North and South Forelands in the region under discussion—seems no valid objection to the present expressive generic use.

From observation in the field and from a study of the forms as shown upon the Ordnance and Admiralty maps, the writer has drawn a probable hypothetical initial shoreline, which is reproduced in Fig. 1. Where the cliffs are higher at the present stage of dissection, it is inferred that the initial coast has been more cut back. By extending the slopes of the upland surfaces, the probable approximate position of the outermost points has been drawn. It is worthy of note that, after allowing a similar extension upon the French coast, there still would remain 3 miles of open water between these two hypothetical shorelines in the Strait of Dover. The ridge of shoals between Calais and Dover may represent an island not yet consumed at the opening of the present cycle, but it seems probable that at this period in the development of the region there was at least some open water between France and England.

Upon both of the maps accompanying this paper (Figs. 1 and 5), the oldland is cross-hatched, the foreland is left blank, the cliff made by the sea eating into the oldland is represented by a double black line with conventional hachures, and the probable initial shoreline is indicated by a broken line.

4. *The Present Coastal Form.*—Between the Thames estuary and the Isle of Wight, the coasts of the counties of Kent and Sussex, or, physiographically speaking, the coasts of the dissected Weald dome, form a succession of headlands nipped back by the sea, alternating with forelands consisting largely of alluviated valleys. If one consults simply an outline map of the Strait of Dover, he will find that the three most prominent points lie north of Dover, south of New Romney, and at Beachy Head. He might easily think that these three were all projecting, because composed of more resistant rock. In the first and third cases this is true, but Dungeness point, south of New Romney, consists of loose detrital waste worn from the rocks of the Weald dome. Why it projects so far into the water in a region of such strong sea abrasion is the question here considered.

While the area of this extensive cuspate foreland is in greater part made up of marshland, and has generally been discussed in the literature of this region as Romney Marsh, still it is almost certain that this valuable agricultural tract could never have been deposited, and then later artificially preserved, if it had not been for the outlying barren tract consisting of gravel and shingle called Dungeness point. Fig. 2 is a reproduction from the geological map of the survey, and shows the relation of the shingle as it exists to-day to the marshes behind. There are many successive ridges of shingle running in varying directions, and often with narrow strips of marsh enclosed between successive ridges. Such bands of marsh have been given the very appropriate name of "slashes" in New Jersey. These successive ridges evidently represent stages in the growth of Dungeness. The shorelines south-west of Lydd are the oldest, since these are less distinctly traced

* *Bull, G.S.A.*, vol. vii., 1896, p. 400.

upon the ground than those near Dungeness light, and since their component pebbles are more weathered. These earlier formed shingle "fulls" are now being cut by the sea, and the flint pebbles are being rearranged in new ridges near the point.

The most recent curves of aggradation are very prettily shown at the point when looking toward the centre of the cuspate foreland from the lighthouse. Recent observations at the point indicate that this shoreline is here advancing at the rate of 9 feet a year. A mile to the west the sea is at present cutting into the shingle. Upon the eastern side of this foreland some twenty-three successive shorelines may be seen between Lydd and the present shoreline. These all curve sympathetically, indicating steps in the growth of the foreland. These ridges are not absolutely

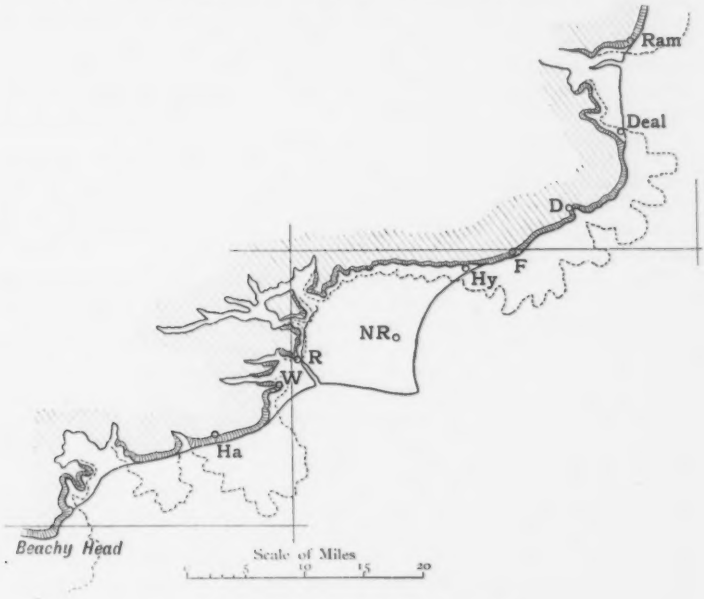

FIG. 1.—SOUTH-EASTERN COAST OF ENGLAND.

D = Dover; F = Folkstone; Ha = Hastings; Hy = Hythe; NR = New Romney; R = Rye; Ram = Ramsgate; W = Winchelsea; cross-hatching = oldland; white areas = foreland; ||||||||| = cliff and nip; ..... = probable position of initial shoreline.

parallel or continuous, for some twenty lines of aggradation at the cuspate point were traced by the writer into fourteen at a point a mile north, and these fourteen were in turn traced into seventeen ridges at a point 2 miles further north. At one time there seems to be greater advance in one place, and when the complex conditions which govern deposition are changed, another point receives the most waste.

Mr. Drew has indicated on Sheet 4 of the 'Geological Survey of Great Britain' the former greater extension of the land into the sea south-west of Lydd, as is shown by the truncated lines of former shorelines, or "fulls," which occur south-

west of Lydd. He says, "The shingle having come from the west and lapped round, so as to make the north and south 'fulls,' it is plain that the most westerly of these is the oldest. . . . The 'fulls' that stretch from Lydd Ripe towards Wigmore Pit were formed earlier, and as these do not curve round to the west, but, after running straight for a mile or two, abut against the present beach, they must have formerly extended further seaward, and have had their ends washed away." *

5. *Ideal Stages of Coastal Development.*—With a general idea of the condition of the coast at the beginning of the cycle, and of the present form of Dungeness and the surrounding coast in mind, the next step is to consider the probable stages in the evolution of such coast and shore forms. The cycle was inaugurated by depression, therefore an irregular, bay-indented, possibly island-fringed initial shoreline obtained. On account of the amount of dissection seen in the Weald dome, approximately in the stage of early maturity, the valleys of the larger streams would have been considerably broadened, while those of the side streams would have been comparatively steep and narrow. This initial coast was attacked by the sea, and, early in the development of the coast and shore forms, a low cliff or "nip" must have been made in the coast all along the shore.

At a later stage in the development, the supply of load was just enough to equal the ability of the sea to transport, and a graded condition resulted. A beach now was seen at the foot of the cliff. This equilibrium would not last at all points, and aggradation would necessarily occur when more waste was supplied than the sea could carry.

The action of the sea in its attempt to eat up the land and re-deposit the abraded detritus in a great off-shore continental delta, which lies below the level down to which the sea is able to abrade, is described here as consisting of two parts, viz. *attack* and *transportation*. While in a general way one may say that the attack of the sea is accomplished by the waves, it must not be forgotten that a very large share of the wasting of the coast is done by the meteoric agents. As with so many other things in nature, the attack of the sea upon the land is a complicated combination of varying factors. To reach a generalization of value, one must carefully balance and weigh these factors.

Transportation may be divided into two classes: on-and-offshore transportation, and along-shore transportation. These two directions of movement are the resultants of all current action. Current is here used in its general sense, meaning any flowing movement or stream of water, and therefore includes the currents of the great ocean circulation, the tidal currents, and the local shore currents, produced by winds, waves, rivers, etc.

6. *Forms of Aggradation.*—The outlying islands would have been most quickly attacked, and were very likely consumed before they were tied to the land by bars, or "tombolos." The writer has proposed to call all such island-tying bars tombolos, taking the name from the characteristic forms uniting Monte Argentario with the coast of Italy. At present there are no such peninsulas in the region of the Weald dome, but further west Portland Bill is joined to the mainland by the tombolo, Chesil Bank.

A second form of aggradation characteristic of later stages of development in such depressed regions is the bay-bar, which is built across drowned valleys in various places by the deposition of detritus transported by along-shore currents from the sides, or pushed up from the bottom by on-shore currents. Behind the

* 'Geol. Folkestone and Rye,' *Mem. Geol. Sur. G.B.* (1864), pp. 21, 22; Topley, 'Geol. of Weald,' p. 308.

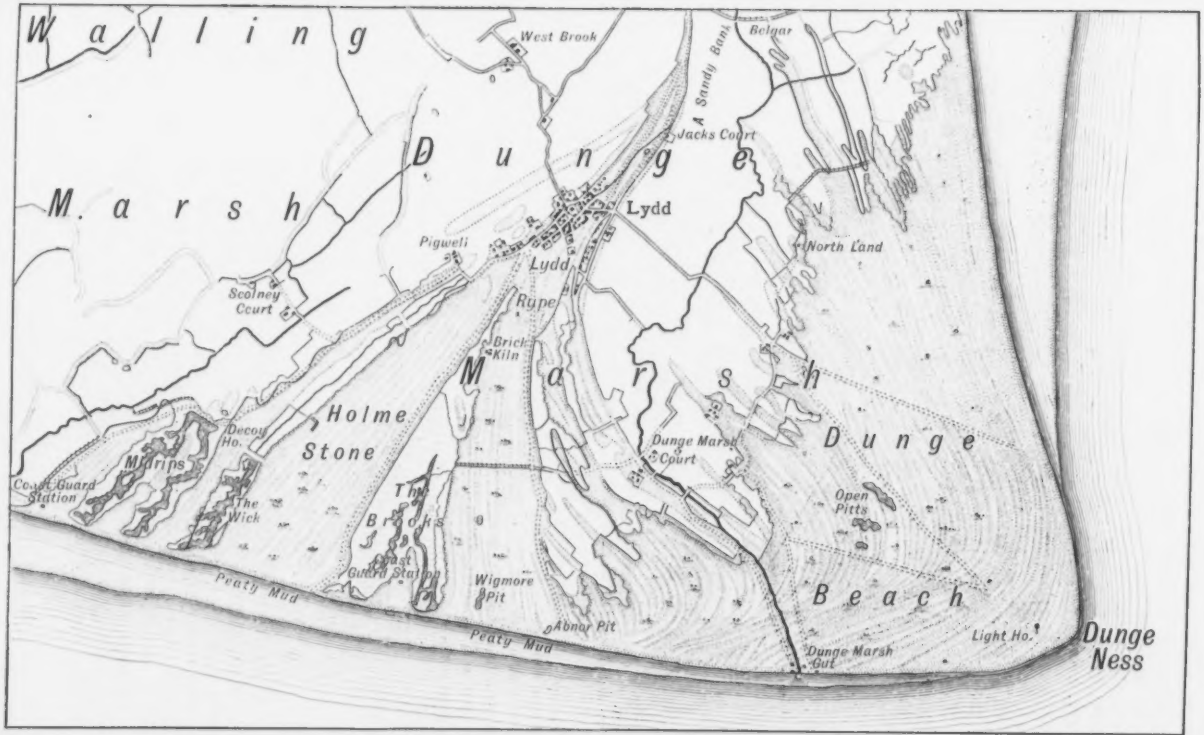

FIG. 2.—SHINGLE RIDGES ON DUNGENESS.

(From sheet 4, Geological Survey of Great Britain.)

Scale of Miles.

0 1 2

bay-bar alluviation will occur, and at the head of the bay a delta will grow. In time the space behind the bay-bar may be completely filled.

Another characteristic feature of the time, when more waste is supplied than can be immediately carried out toward the continental delta, is what may be called a tidal cuspate foreland. It is found in regions of drowned valleys, long inlets, or narrow sounds, where the opposing shorelines are approximately parallel to each other. When the on-and-offshore currents cannot distribute all the detritus, some of it must be carried by the along-shore component of the total current force acting, and deposited where the movement of the water is least. Where these forelands occur there are always found comparatively strong tides, so the tidal in-and-out flow is considered to be the determining agent in their production. Upon either side of the main current of the ebb and flood must be found more or less of an eddy circulation set up between this principal body of flowing water and the coast, and in the triangles of comparatively dead water between the several members of these small eddies of water a V-shaped bar will be formed, similar to that represented in Fig. 3. This V-bar will at first enclose a lagoon, which is in time converted at later stages into marsh and meadow land. Another method of growth of such tidal cuspate forelands is where the aggradation begins at the shoreline at the foot of the earlier formed "nip," and proceeds by successive steps outward into the channel. A typical example of the first class of tidal cusps is seen in West point, north of Seattle, in the state of Washington; * while an example of the second class is found in the same general region in False Dungeness harbour, or Port Angeles. A longitudinal section of a tidal cusp is given in Fig. 4.†

FIG. 3.—IDEAL V—BAR STAGE.

FIG. 4.—LONGITUDINAL SECTION OF A TIDAL CUSP.

7. *The Nipped Oldland.*—From the deductive study of what might be expected in such a region of submerged subaërially-carved topography, let us turn to the foreland as seen to-day, and see if the new features suggested by the theoretical consideration are to be found. In Fig. 1 the general relations of the foreland to the oldland are given, while in Fig. 5 the characteristic features of the foreland are shown upon a larger scale. The areas of shingle are given in Fig. 2, with the exception of the narrow strip which extends from Hythe toward New Romney, and which for many centuries has been added to by man to form the Dymchurch wall, protecting the rich fields of Romney Marsh from the easterly storms.

* See 'U.S. Coast Survey Chart,' No. 658.

† *Loc. cit.*, No. 646.

If one walks across the flat surface of this great marsh northward from Dymchurch, he comes to a point north of the canal and westward from Hythe where there is a sudden change in slope. From the level plain one ascends a more or less steep slope across the narrow belt of Weald clay to the steep infacing escarpment of the Lower Greensand. To the west one sees the "inface," or retreating surface of the more resistant member of the Lower Greensand, carved by subaërial denudation, while to the east near Hythe the line of the present cliff and the former nip back of the foreland cuts diagonally across the direction of the escarpment. Further west, where the foreland abuts against a broader belt of the Weald clay, there is a less marked change of slope, but the line of the nip can be fairly well traced. Topley recognized the action of the sea upon the oldland previous to the growth of this foreland. He said, "Along the northern boundary of Romney Marsh the termination of the Weald clay is certainly an old sea-cliff, now worn down into undulating ground."* The railway has taken advantage of this gentle grade across the nip in entering the area of the marsh, instead of taking the route by the larger town of Hythe, where the engineering difficulties were much greater, both on account of steeper sea-cliffs, and also because the escarpment is more pronounced than further west at Ashford, where the oblique faults† probably lessen the resistance of the harder rock or *inface-maker*.

Upon the western side of the foreland the nip is found upon the irregular headlands and islands of the Hastings beds, which were formed by the depression inaugurating the present cycle. This nip extends for some little distance up the aggraded bays between Appledore and Winchelsea, as is indicated diagramatically upon the accompanying maps. Near Appledore the nip is not at all pronounced, so that one, in entering this region by rail, hardly knows when he passes from the oldland to the foreland. Further south, upon the military road north of Rye, the nip is more pronounced, indicating that the marsh-filling occurred here at a later date. That up to a comparatively late date this was a more or less open lagoon through which the ships passed on their way to the port of Appledore, is suggested by the historical studies of this region, to which references are given in a later section.

8. *Bay-bar to V-bar.*—At the beginning of the cycle the area under discussion was the great Appledore bay, situated between the initial headlands which must have existed in front of the present cliffs, cut in the oldland at Folkstone and Hastings. As soon as grade was reached in the abrasion of the Hastings headland and along-shore transportation had commenced, there would have been a tendency on the part of the sea to attempt to close Appledore bay by a bar, extending northeast from Hastings headland. Such a bay-bar is indicated in Fig. 5, by the line of dashes, with one dot between each pair of dashes (1—1). The direction of the bar is taken from that of the oldest shoreline, now seen south-west of Lydd, and is extended to meet the Hastings headland. It seems highly probable that this first shingle spit was straight, as is indicated in the figure; but it is also possible that even at this early stage the bar had something of a cuspate form, as has been indicated in all the succeeding stages. We know definitely the position of the north-eastern end of this early bar, and that the initial headland must have been to seaward of the present Hastings cliff. All but a very small portion of the material of this early bar has since been rearranged.

Five successive steps in the outgrowth of Dungeness foreland are indicated in Fig. 5. There are many more intermediate positions of the shoreline indicated

* Topley, 'Geol. Weald,' pp. 251, 302.

† *Loc. cit.*, p. 252.

in the shingle "fulls," as one will see by looking at Fig. 2. One shingle ridge often fits closely up to the last, while frequently a narrow lagoon, or slash, occurs between two successive ridges. To illustrate the writer's theory of the formation of the point, five characteristic stages have been selected. The shoreline with the

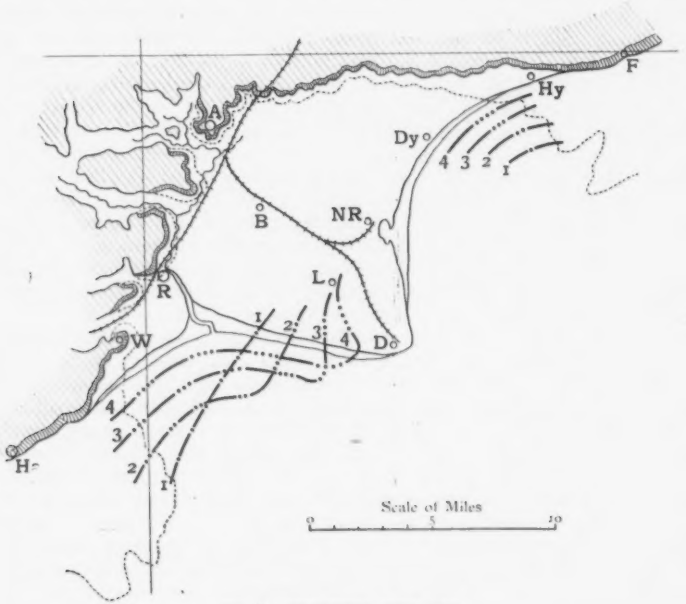

FIG. 5.—DUNGENESS FORELAND.

A = Appledore; B = Brookland; D = Dungeness; Dy = Dymchurch; F = Folkstone; Ha = Hastings; Hy = Hythe; L = Lydd; NR = New Romney; R = Rye; W = Winchelsea; cross-hatching = oldland; white area = foreland; ||||||| = cliff and nip; ..... = probable position of initial shoreline; ——·—— = next succeeding shoreline stage in growth of foreland; ——··—— = second succeeding shoreline stage in growth of foreland; ——···—— = third succeeding shoreline stage in growth of foreland; ——····—— = fourth succeeding shoreline stage in growth of foreland.

sharpest curve is found to the east of Lydd (stage 4), and upon the coast to-day this shoreline gives a sharp turn to the west. During this fourth stage, as represented in the figure, the foreland had probably its most cuspate form. It is now more blunt, and the curves of the earlier shorelines indicate that the foreland became sharper and sharper up to the stage marked (4).

The lines of dashes with respectively one, two, three, and four dots, as given in Fig. 5, show more clearly than words can do the writer's idea concerning the successive positions of this shingle. One must remember that the fixed points in these stages are the north-eastern ends of the four shoreline stages, and that the curves to the Hastings headland, as well as the form of the headland itself, might be more or less altered. Upon the Hythe side of the foreland there are no fossil shorelines. The Folkestone headland must, however, have extended further sea-

ward, and grade was probably attained before the coast was cut back to the present position; so the shingle now incorporated into the Dymchurch wall probably represents the present position attained by a receding series of wing-bars extending from the Folkestone headland. The five stages near Hythe, upon the right side of the foreland (shown in Fig. 5), may roughly correspond to the five upon the left side.

Dungeness foreland, then, appears to represent a transition from a bay-bar to a cuspate foreland. The wing-bar attempted at first to close Appledore bay, and then, on account of eddies, changed its nearly straight form into a cuspate point, which advanced gradually from south-west to north-east.

9. *The Rother and Aggradation.*—After the drowning of the land at the beginning of this cycle, the river Rother and its side streams began to build deltas in the narrow submerged valleys at the western end of Appledore bay. These small deltas, at a later time, became confluent between Appledore and Winchelsea. As soon as the shingle-bars extended far enough across the bay to make the water inside comparatively quiet, aggradation began, sediment being brought by the streams, the tides, and the winds.

It is very probable that the Rother had two main distributaries a thousand years ago: one, the Limen river, flowing out through an inlet in the bar south-west of Hythe, and the other flowing past Old Romney. It does not seem necessary to make the second course subsequent to the first.* In the course of this aggradation the river Rother, probably, many times shifted its course across these tidal flats; the last important change occurring in the thirteenth century, when the Rother at New Romney was silted up during some heavy storms, and was obliged to cut another outlet further west across the shingle bar. The whole marsh between Appledore, Brookland, Lydd, and Rye, was doubtless flooded, and the overflow occurred where the shingle protection was the weakest—west of all the fossil shorelines (Fig. 5).

In the English Channel the flood tide makes from the south-west to the north-west much more rapidly than the ebb in the opposite direction. The direction of the dominant movement of drift has been observed to accord with the direction of the flood tide. That the Dungeness foreland has been produced by the meeting of the tides of the North Sea and the English Channel has been suggested by Redman.† It has been very common to attribute the formation of this great deposit to the tides, but the details of the process have not been explained, except in a most general manner, by the expression "meeting of the tides."

10. *Historical Studies.*—The geographical interpretation from form is corroborated by the history and tradition of Romney Marsh. The Dymchurch wall is an ancient sea-wall, early strengthened by man to enclose and protect the rich alluvial tracts behind.‡ The Rhee wall from Romney to Appledore is of Roman times, for Roman coins are found in the enclosed alluvial beds. The Roman wall is very likely built on an earlier structure. The forms of natural aggradation by tides and currents along the shore has been much altered by the work of man. Much low marshy land was early "inned," *e.g.* Boniface, Baldwin's, Denge, besides the great Romney Marsh.

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* See Drew's account of these changes in Topley's 'Geol. Weald,' pp. 302–312.

† "On the Alluvial Formation, and the Local Changes of the South Coast of England," *Min. Proc. Inst. Civ. Engr.*, vol. xi. (1852), pp. 162–204. See also Topley, 'Geol. Weald,' p. 304; Lyell, 'Prin. Geol.', fifth edit., 1867, vol. i. p. 529.

‡ Montague Burrows, 'Cinque Ports,' 1892; Robertson, 'Archæologica Cantiana,' vol. xiii. 1880, p. 275; Wm. Hollaway, 'The History of Romney Marsh' (London, 1849); Wm. Somner, 'Roman Ports and Forts in Kent' (Oxford, 1693).

The historical study of the changes of form of Romney Marsh has been considerable, particularly on account of the question as to where Cæsar landed in Britain.* Romney, one of the Cinque Ports of ancient south-eastern England, has completely lost its coastline.† And now New Romney cannot claim any of the seafaring glory of its ancestor.‡

Mr. A. J. Burrows § has made out from historical data changes in Romney Marsh which suggest the above geographical interpretation. The drawings of former positions of the spits and shingle beaches, which accompany the paper by Mr. Burrows, were not constructed with this type of tidal foreland in mind; but with a slight change in the direction of the hypothetical curves to accord with the geological evidence, all these former shorelines fall into a successive series of sympathetic curves, outlining a broadly cuspate foreland.

The relation between geography and history can be very well shown in Dungeness foreland, and a review of the historical data in connection with the structural indications of former stages of development, would make a most interesting study. The historical students of Romney Marsh have not sufficiently regarded the fossil shorelines indicated by the ridges, and have placed too much reliance upon outlines given on early maps, which generally show poor sketching and little appreciation of geographical form. The question of property lines, as determined by old surveys upon this area of shifting alluvium, has an important connection with the historical problem.

English sailors have recognized in other parts of the world forms similar to Dungeness foreland, and have applied the same name to two widely separated deposits, both having a similar geological structure. One is in Puget sound, and the other is south of Patagonia, in the Strait of Magellan.

RUSSIAN EXPEDITIONS IN TIBET.

I.

M. V. Pyevtsoff's Expedition, 1889-1890.‖

The Russian Geographical Society has added two more volumes to its admirable collection of works upon Central Asia, namely, the first and the third volumes of the 'Works of the Tibet Expedition, 1889–1890, under M. V. Pyevtsoff.' The first of them contains the leader's general record of the expedition, and the second embodies the records of Roborovsky's and Kozloff's "excursions"—that is, reconnoitring journeys into the highlands of the northern border-ranges of the Tibet plateau. Both volumes are admirably published, and the former contains an excellent "Map of Eastern Turkistan and the Northern Border Highlands of the

* F. H. Appach, 'Caius Julius Cæsar's British Expedition from Boulogne to the Bay of Apuldore, and the Subsequent Formation Geologically of Romney Marsh' (London, 1868).

† See 'Cinque Ports,' by Montague Burrows (1892), for the historical recorded changes upon Dungeness.

‡ For an account of the great invasion of the sea in 1287, see Hasted, 'History of Kent,' vol. viii. p. 448; Robertson, 'Archæologica Cantiana,' vol. xiii. (1880), p. 237.

§ The Surveyors' Institution *Transactions*, vol. xvii. (1885), pp. 335–376.

‖ 'Works (*Trudy*) of the Tibet Expedition. 1889–1890, under M. V. Pyevtsoff.' Part i. and part iii. Published by the Russian Geographical Society. St. Petersburg: 1896.

Tibet Plateau" (40 miles to the inch), as well as forty excellent photo-engravings, which, better than pages of text, give an idea of the snow-clad mountains, the high dreary plateaus, the oases, and the lakes of the region, and partly of the inhabitants. A portrait of General Pyevtsoff is also added. The other volume (part iii.) contains five maps (13 miles to the inch) of the regions visited by Roborovsky and Kozloff during their incursions into the highlands.

Much of what was veiled from our knowledge during that expedition has already been disveiled by both Roborovsky and Kozloff's last expedition, or by the explorations of British explorers, especially of Mr. Littledale. The terrible Takla-makhan desert, in the midddle of Chinese Turkistan, has been crossed by Pyevtsoff's own comrades during their subsequent expedition, and our knowledge of the borderlands of the Tibet plateau has already been extended. And, nevertheless, the two volumes before us are full of interest.

After the death of Prjevalsky, his comrades, M. V. Pyevtsoff, V. L. Roborovsky (botanist), and P. K. Kozloff (zoologist), who were joined by a geologist, K. I. Bogdanovich, started under the leadership of M. V. Pyevtsoff. They left the town Prjevalsk, crossed the Tian-Shan *viâ* the Bidel pass, and came to Yarkand. Then, following the lines of oases, they passed through Khotan, Niya, and Cherchen, at the northern foot of the border-range of the Tibet highlands, making incursions into these highlands and exploring the "Russian mountains," which make the western part of the Astyn-tagh, and the Akka-tagh, which has received since from the Russian Geographical Society the name of "Prjevalsky's range." * Thus they reached Lob-nor, and then, turning northwards, went to Karashar, Urumchi, and Port Zaisan in Russian Turkistan. We thus find in General Pyevtsoff's record (vol. i.) a wealth of information about the physical condition and the inhabitants of these oases; and, both in the first and third volumes, most interesting data in the structure of the outer fringe of the Tibet highlands, from the meridian of Khotan to Lob-nor (10° to 90° E. long.).

The work of General Pyevtsoff opens with an excellent "Historical and Geographical Sketch of East Turkistan," followed by a chapter on the journey from Prjevalsk to Yarkand *viâ* the Bedel pass. The next chapters, devoted to the description of the Yarkand, Khotan, and other oases, are extremely interesting. One would hardly suspect, for instance, that they would be so densely peopled as they are. Thus, the small Yarkand oasis (264 square miles) has a population of 150,000 according to the last census—that is, 567 inhabitants per square mile. The land is, of course, admirably cultivated, and all agricultural produce is cheap; while the few Indian goods which are imported *viâ* Ladak on horseback—the journey lasting thirty-five days—have to support a cost of transport of from 8s. to 10s. for each 36 English pounds. The next oasis, Kargalyk, has also a very fertile soil, and, although it covers only 132 square miles, its population attains to 30,000 inhabitants.

From Kargalyk the expedition went southwards to spend the hot months of July and August in the mountains, the spot Tokhta-khon having been chosen for that purpose. The spurs of the Kuen-lun are named here Topa-tagh (Dusty mountains), and strike the traveller by the incredible steepness of their slopes, the sharp edges of their crests, and the numbers of deep and narrow valleys intersecting them. No pass across these mountains that would be accessible to horse, or even to man, is known, with the exception of the Topatagh-davan. The rivers, after each rain or when the snows are thawing, rush through these narrow valleys with a fearful

* Astyn-tagh, not Altyn-tagh, as it stands on the map and in Pyevtsoff's text, as is pointed out by the editor in part iii. of the present work.

force. Only about a hundred Tajiks from Vakhan inhabit that part of the mountains. While staying here, the expedition received the welcome visit of M. Dauvergne, Major Cumberland, and Lieut. Bower, all coming from Ladak.

On September 13 the journey was resumed along the northern slope of the border-range. They visited the Khotan oasis (440 square miles, 130,000 inhabitants, to which the 30,000 inhabitants of the next two small oases, Zava-kurgan and Kara-kash, must be added), less fertile than Yarkand, but very well cultivated also, and distinguished by its various petty trades and cotton plantations, silkworm-culture being temporarily in a poor state on account of a silkworm disease. A lively trade in all sorts of wool is carried on with Russian Turkistan and partly with Ladak (*viâ* the Kilian pass). The next oasis, Chila (7000 inhabitants), owes its wealth chiefly to its fine sheep and silkworm-culture; while Keria (97 square miles, 14,000 inhabitants) is less densely populated than Khotan, and is given, to a great extent, to the culture of cereals—wheat, rice, and barley. The Keria river carries a considerable amount of water, and consequently penetrates for 200 miles into the Takla-makhan desert. And finally, the Niya oasis has only 9 square miles and 1850 inhabitants. On November 29 this last oasis was reached, and the expedition wintered there.

The next chapter is devoted to an ethnographical sketch of Kashgaria, whose population is estimated at 2,000,000, including about 200,000 nomads, and nearly 6000 Dungans, who have immigrated from China during this century; there are, besides, some three hundred families of Tsiganes. The oases are separated by deserts covered with small gravel (*sai*), and of difficult access during the hottest part of the summer. The layers of loess, of which the soil of the oases consists, but which are far thinner than in China, constitute their wealth. The high culture of these latter can best be seen from the fact that land attains very high prices—from £10 the acre in the less populous oases like Keria, to nearly £30 the acre in the Yarkand oasis. Irrigation stands at a high degree of perfection, and is learned by every inhabitant from early childhood. A common play of the children is to make miniature canals leading to their miniature play-fields, and irrigating them with water drawn from the real *aryks*. A European can only wonder at the clever way in which the natives solve the most difficult problems of irrigation. Elected elders (m'rab or aryk-aksakal) regulate the turn amongst the landholders for irrigating each field, and settle the possible disputes. Indian corn, wheat, rice, barley, two kinds of sorgho (*jugara* and *taryk*), and peas are grown, as well as lucerne, the wheat crops being from twenty-eight to forty to one. Cotton, flax, hemp, kunjut, poppy, tobacco, saffron, and madder plantations are the other cultures, the best cotton being obtained in Khotan and Keria. Hemp is grown for hashish, which is exported to India. In fruit-growing the Kashgarians excel, but they grow no almond and pistachio-trees, which are, on the contrary, so common in Russian Turkistan.

General Pyevtsoff's sketch of the inner life of the Kashgarians—condensed, but full of interesting details—is very good, but could not be further considered here. He knows the people well, in all the details of their inner life, and has a high opinion of their sweet, honest, and amiable character, spoiled only by such features of servility as are fully explained by the recent history of the region. "An impartial explorer must recognize," he writes, "that the moral standard of the Kashgarians is very high. Robberies, arson, and murders are extremely rare, and are considered as a general misfortune; and theft is rare—much rarer than in Europe, with the exception, perhaps, of Scandinavia." Though Sunnite Mussulmans, the Kashgarians are by no means fanatics.

Kashgaria, as is known, forms part, since 1884, of the Sin-tsian province of

China, and is under a governor-general residing at Urumchi. It is divided into two provinces, Ak-su and Kashgar, under two *dao-tais* (governors), each province being divided into districts (Ak-su, Uch-Turfan, Kuchas, and Karashar; Kashgar, Yarkand, Kargalyk, Khotan, and Keria). Each district is divided into several bek-doms, the beks being elected by the Chinese from among the natives. Each village has its elder (*aksakal*), and there are besides milleniers, centurions, and decarions (*min*, *our*, and *yuz-bashis*). The richer natives seem to like Chinese rule, while the poorer classes prefer the rule of Yakub-beg, who was, they say, poisoned by the Chinese.

The winter in Niya (37° 5′ N., 82° 40′ E., altitude 4460 feet) was relatively mild. Cold winds from the north-east, accompanied by dust-fogs, began only in December, and then the cold reached 11° Fahr., and even 5° Fahr. at night. Snow fell only thrice (0·1 inch, 0·05, and 0·3), and this last, in February, lay on the ground for three days. Fearful storms, carrying with them a thick dust, and producing sometimes absolute darkness, began in February. The dust sometimes covered the ground three-tenths of an inch thick, and traces of animals were then seen on it just as they are seen upon fresh snow. Dust-storms were altogether so frequent, that the mountains (25 miles distant) could only be seen four times in five months. Spring began in the end of February, and already, in the middle of that month, the geologist, K. I. Bogdanovich, began his excursions towards the mountains, and Roborovsky soon followed him.

On May 6 the expedition left Niya, and continued to follow the foot of the border-range. Its northern slopes have for inhabitants the *táglyks* only (mountaineers), "who differ," General Pyevtsoff says, "from the inhabitants of the oases by their shepherd life, and perhaps by a still greater purity of manners." They spend the winter in their very poor and small villages, but when the summer comes, they go with their flocks of sheep to the higher valleys and camp there. They have, however, no tents, but have in the valleys many caves, which were excavated in the loess or conglomerate cliffs, with a fireplace and chimney, and stay there. They accompanied the members of the expedition in all their mountain rambles, and won their full sympathies. They are admirable in mountain rambles, but have a superstitious dread of the high desert which lies further south.

Occasionally, when the winter is very cold, they move to a higher level in the mountains, probably because the temperature is milder there than in the valleys exposed to the cold anti-cyclones (p. 218). Speaking of winds, it is worth noticing that every day in May and June a cool wind used to blow from the north, *i.e.* from the Takla-makhan desert, between 11 a.m. and 5 p.m., while at night the wind was from the south, from the mountains. The existence of a cool wind blowing from the desert was the more astonishing, as it was known that since the 15th of May great heat prevailed at Niya, and the heat must have been simply unbearable in the desert. What the temperature in the desert must be in summer may be judged by the fact that on its border the heat reached 80° Fahr. in March, and the sand was heated to 140° Fahr. In summer its temperature must be 180°, or more. An ascending current of hot air must consequently exist over this immense desert, and the hot and extremely dry air of the desert, on rising to a higher level, must lose a considerable amount of its heat, which energy is spent during the ascent of the air. Considerable masses of cooled air must therefore accumulate at the higher levels of the atmosphere over the desert, and they must flow in all directions towards the surrounding mountains. General Pyevtsoff remarked, indeed, that the cold wind, which attained a speed of from 10 to 35 feet per second at lower levels, and up to 50 feet higher up in the mountains, was *not* a horizontal wind; and by means of a specially devised apparatus, he found out that its angle with the

horizontal line was from 5° to 10°, the dip being from the desert towards the mountains. The same air-current was noticed later on in July and September as well.

The chief aim of the expedition was to penetrate as far as possible southwards into the plateau of Tibet, but almost unconquerable obstacles stood in the way. From Kashgar eastwards, to the meridian of Keria (81° 30′ E. long.), the mountains which enclose Kashgaria run, as is known, from north-west to south-east. From that meridian the border-range takes a direction from south-west to north-east, and is known under the name of "Russkiy Khrebet" in its western portion, and Astyn-tagh further east till the longitude of 93° E. Many rivers pierce this immense border-range, in which, or in whose spurs, snow-clad mountains, rising above 20,000 feet, tower here and there (the Ak-tagh, 36° 40 N., 84° 50′ E., reaches 20,880 feet). The high valleys of these rivers, before they have pierced the border-range, lie at heights of from 12,000 to 14,000 feet, and these valleys are still of a relatively easy access. The members of the expedition did, in fact, explore most of them. Thus the valley of the Tolan-khoja, in the south of Niya, was visited by Roborovsky; Lake Dashi-kul (13,880 feet), close to the Ak-tagh peak, was visited by Pyevtsoff; and a large tract of land on the plateau was explored in the south of Cherchen and Lob-nor, namely, the upper Cherchen-Daria and the Togry-sai, both separated by a range (Muzluk, Achik-kol, or Moskovskiy) from lakes Achik-kul (14,320 feet) and Unfreezing, or Lyag-kum-kul (13,300 feet).

But an immense chain of mountains, the Akka-tagh, or Prjevalsky's ridge, rises in the south of these parts of the plateau, and separates them from the true North Tibetan desert. One of the peaks of that mighty chain was found to attain the altitude of 23,700 feet (under 87½° E. long.). Immense portions of it are snow-clad, and the Kashgarians, as a rule, very rarely cross this chain. Pyevtsoff's expedition succeeded in crossing that range and pushing southwards for a short distance into the desert in two places only. Roborovsky did so in the south of Niya, under the 83rd degree of longitude, and there nearly lost his life. When he entered the desert, he found it utterly devoid of all vegetation. A distance of 22 miles was covered before the party met with a few bushes of willow. The surface of the desert was covered with rows of sharp quartzite *débris*, being the heads of quartzite strata running west and east; but even no mosses or lichens would grow on these stones, never watered by rain. Only snow falls all the year round in that dreary flat desert, having an altitude of over 17,000 feet. Roborovsky pushed for 40 miles southwards (to 35° 40′ N.), but all his horses, save one, broke down, and the party nearly perished in a snowstorm.*

Another attempt to push beyond Prjevalsky's range was made by Pyevtsoff in the south of Dashi-kul. What these mountains are is best seen from the admirable photographs illustrating the volume under review. To cross the border-range was already very difficult,† and a halt of five days had to be made at Dashi-kul, to let the horses recover, which was again by no means easy, on account of the scarcity of fodder. Only bones of birds, which must have perished in their migrations, and skulls of wild yaks (different from the wild species known in North-East Tibet) were found around the salt lake Dashi-kul (13,880 feet). A basis was measured for geodetical measurements on the shores of this lake, and several heights were determined: Ak-tagh, 20,880 feet; lower limit of snow-line on the south slope of the Astyn-

* See vol. iii., where this "excursion" is described in full, and a map, 13 miles to the inch, is given.

† M. Pyevtsoff always says "the Kun-lun;" but, to specify, it must be borne in mind that it is of the Astyn-tagh that he speaks in this place.

tagh, 19,140 feet; end of a glacier on same slope, 18,080 feet. The rate of propagation of sound in this rarefied air (barometer, 17·95 inches) was also measured by the aid of the chronograph, and was found to be 1073 feet per second. As soon as the party, proceeding southwards, entered one of the transverse valleys of Prjevalsky's range, they found plenty of traces of antelopes, Tibetan hares, and kulangs, although the vegetation remained still extremely poor. The top of the pass had an altitude of 16,590 feet, and a beautiful view opened southwards. An immense high plain was seen, with rows of low ridges running upon it from west to east; further to the south-west a high ridge was seen, which went further and further and was lost below the horizon in the south-east. To the north masses of mountains appeared, their relative heights increasing, or, in other words, more and more deeply ravined as they were receding from the main range. The southern slope of the Prjevalsky range was very short, as it lies on the high plain, at a height of 16,100 feet. Water boiled there at 183° Fahr., and meat could not be boiled. Next day, July 9, a thick snow began to fall, but in one hour all traces of it disappeared, owing to sunshine and rapid evaporation in that dry air. No traces of river-beds or of any running water were seen; it must never rain in those deserts. The soil was gravel, with rows of hard slates appearing from beneath it. It was covered with fissures 5 inches wide—probably due to frosts—which were also filled up with gravel. In lower spots some moisture was found, nevertheless. The *Eurotia*, of a miniature variety, with thick roots, was the only plant seen—even lichens and mosses do not grow; but still a few *orongo* antelopes and one crested lark were met with, and traces of kulangs, hares, and Tibetan steppe-partridges were seen. The same dreary landscape was sighted from a mountain (16,150 feet above the sea-level) which Pyevtsoff and his small party climbed upon, and the same high ridge was seen running to the south-west. A terrible snowstorm, with thunder, compelled the half-frozen party to return.

From all his information, General Pyevtsoff concludes that all hope to explore this desert from the north, without spending a very considerable amount of money in organizing a row of depôts, must be given up; the more so as there are no *yaks* in Kashgaria, and *yaks* are the only beasts of burden which could live in those deserts without requiring fodder being brought for them from the lowlands.

From Bashi-kul the expedition returned to Karasai (at the foot of the Russkiy range), and thence went to Cherchen, crossing the Achanyu sands (a very characteristic photograph of these sands at Kara-muran is given; while another photograph admirably illustrates how the poplar forests die out on the borders of the Takla-makhan desert, being buried in loess dust). The Cherchen oasis has now lost 2000 out of its 3500 inhabitants, who fled to escape the heavy work which was imposed upon them by the Chinese, as they compelled them to dig out a new irrigation canal, never ended and now abandoned.

The expedition once more approached Prjevalsky's range, near Lake Yashil-kul (87½° E. lat.). This range runs without interruption over all the length from Dashi-kul to this spot, and rises above the snow-line. In the east of the meridian of Cherchen the snow-clad peaks grow more and more numerous, the highest of them being said to be the Tyumenlyk-tagh, about 180 miles to the east of Yashil-kul. There the range is said to bend toward the south-east (Marco Polo range?), entering a land which is unknown to the Kashgarians. In its northern spurs, especially further eastwards, good grazing grounds are said to be occasionally found. To the south of it stretches a land much higher than the valley between the Akka-tagh and the Astyn-tagh—that is, of a higher altitude than 14,000 feet. The hunters know that it is higher on account of the difficulties of breathing they experience,

and the length of the slopes. It never rains there, only some snow falling; and there are no high mountains—only hills upon its surface, with occasional depressions. All is covered with gravel, the only vegetation being the white willow (*Eurotia*) and a Tibetan *Carex*. There are no rivers nor lakes, but there are wet spots where a hole, being dug in the ground, soon fills up with water. Only a few wild yaks live in that desert, and this in summer only; but no other mammals, nor birds, nor reptiles have ever been seen by the hunters. Such is the "land beyond the clouds," as it is described by the hunters, who enter it only when they pursue wounded yaks. If a wounded yak crosses the border-range, they load a donkey with a provision of barley, and follow the track of the wounded animal, sometimes making a two days' journey beyond the border-range. When the yak has been killed, the best pieces of its meat are put on the donkey and brought to be sold to the gold-diggers, who stay on the northern slope of the Prjevalsky's range. The best pass across this chain is at the head of the Gükerma river.

When Roborovsky returned from his excursion to Lakes Unfreezing and Achikkul, during which he explored a wide region between the Astyn-tagh and Prjevalsky's range (described in vol. iii.), and covered no less than 500 miles, the expedition begun its return journey.

They visited the Lob-nor (2650 feet) and the Tarim, whose proper name is Yarkend-daria (*tarim* means "a tilled field" in Kashgarian). The lake rapidly desiccates, and a very old man, 110 years old, whom Pyevtsoff spoke to (his son, fifty-two years old, was the only one who could understand the old man), said that he would not have recognized the land if he were absent all this time. Ninety years ago there was only a narrow strip of rushes in the south-west part of the lake, and the Yarkend-daria entered it 2½ miles to the west of its present mouth, where now stands the Abdal village. The lake was then much deeper, and several villages, now abandoned, stood on its shores. There was also much more fish, and otters, which used to live there, but have long since disappeared. As to the Yarkend-daria, tradition says that two hundred years ago it used to enter another smaller lake, Uchukul, which was connected by a channel with the Lob-nor. This old bed, named Shirga-chapkan, can be seen still by the trees which grew along it. The greater previous extension of the Lob-nor is also confirmed by the freshwater molluscs (*Limnæa uricularia*, var. *ventricosa*, *L. stagnalis*, *L. peregra*, and *Planorbis sibiricus*), which are found at a distance from its present banks. Another lake, 400 miles in circumference, Kara-boyön* (*black isthmus*), lies, as is known, 27 miles to the south-west of Lob-nor. To the east of the lake, a salt desert stretches for a seven days' march; and further on begin the Kum-tagh sands, where wild camels live.

The return journey, from Lob-nor to Karashar (88 square miles, 11,000 inhabitants, out of whom 10,000 Dungans), and thence to Urumchi, is also described with many interesting details, of which we only will mention the discovery of the Luk-chun depression, whose surface is below the level of the ocean. It was first discovered by the hypso-thermometer, which shew to Bogdanovich the quite unexpected temperature of boiling water, 212·63° Fahr. The barometer was immediately opened, and confirmed the indications of the former instrument. It stood at 30·55 inches, and the temperature of the air was so mild that the high stand of the barometer, continued on the next two days, could not be explained by the prevalence of a barometric maximum which, in Central Asia, is always accompanied by cold weather. The altitude of this depression was thus found to be 164 feet below the ocean—a fact which was also found in October, 1889, independently, by

* Not *Kara-buran*, as it stands on Prjevalsky's map.

Grum Grjmailo, and later on was fully confirmed by Roborovsky and Kozloff's expedition. This depression is now known to have a length of 95 miles and a width of 27 miles, including the town of Turfan and the villages of Luk-chun, Assa, Pichan, and Toksun.

From Toksun the expedition went to Urumchi (15,000 inhabitants, out of whom 13,000 Dungans and 2000 Chinese), and thence to the Russian post Zaisan, following a new route past Telli-nor (960 feet), and the Chelikty pass. The post was reached a few days before the New Year's Day of 1891.

The above sketch gives, of course, but a very imperfect abridgment of the interesting contents of the first volume, and still less of Roborovsky's and Kozloff's work related in the third volume. It would be most desirable, at the same time, that an abridged edition be published of these volumes, and, in fact, of all the series of volumes on Central Asia, lately issued by the Russian Geographical Society. It would be in the interests of geography in Russia itself, and of science too, that such abridged editions be published in Russian (similar to what was issued in Sweden, for the general reader, after the first Spitzbergen expeditions), and they would most certainly be translated into all European languages.

II.

The Conclusion of Roborovsky's Expedition, 1893–1895.

The last number of the *Izvestia* of the Russian Geographical Society contains the last instalment of the preliminary reports of Roborovsky's Tibet expedition. It is written by P. K. Kozloff, and reveals in the author a not common gift of descriptive power. By the end of July of 1895, the expedition left, as is known, the Nan-shan mountains and went northwards, across the Hami desert and the eastern spurs of the Eastern Tian-shan, to the Russian post of Zaisan. From Hami Kozloff made an "excursion" in the mountains, that is, covered some 400 miles with his surveys. He now gives both a general sketch of that part of the Tian-shan, as well as a more detailed record of his mountain journey.

The eastern part of the Tian-shan, to the east of the Hami-Barkul route, stretches from north-west to south-east for about 100 miles. Its middle part is snow-clad for nearly 35 miles, and there are no passes through this part of the chain. The natives know it under the name of Karlyk-tagh (snow-mountains). Both slopes are very steep, the snow-line lying on the northern slope, at Yashil-kul, at a height of 12,000 feet, while the peaks enclosing one of the glaciers visited rise to 15,000 feet. The steepness of the glacier is appalling; towards its end it falls almost vertically, and has ice-cascades. The glaciers of the northern slope, on issuing from the main chain, give origin to a mighty stream, named Ak-tuguruk. It pierces the Mechin-ola mountains, and flows north for 20 miles across the desert, to be lost in the Noma oasis. The streamlets of the southern slope unite in the Naryn, and feed the oasis of Hami. From the last snow-clad peak which lies farthest east, the Karlyk-tagh spreads in several radial chains, and in the meridian of Bai the Tian-shan nearly ends—only a dreary, narrow, and low chain marks it; but further east it rises again in the rocky Emir-tagh, to be lost finally in the stony desert which stretches further to the south-east.

Only the northern slope is covered with vegetation, which is there very rich, and offers a beautiful sight. The upper limit of the tree-zone attains 9000 feet; higher up lie the alpine meadows. The Siberian larch and the fir (*Abies Schrenkiana*) make the forests, with a variety of under shrubs, while the *ak-dark* poplar is characteristic of the valleys. On the southern slope the vegetation is destroyed by the dry heat, and both vegetation and man seek refuge in the

narrow gorges, which are all the more beautiful on account of the contrast with the surrounding burned desert. The fauna of the Eastern Tian-shan is the same as in its western portion, but is somewhat poorer; bears and fallow deer are unknown, and stags are rare.

Nearly five hundred families of Chantus, or Taghchis (mountaineers), from Hami, live in small villages in the mountains up to altitudes of 7500 feet, growing some barley and wheat, and partly living a nomad life with their cattle. They have splendid grazing-grounds, keep a considerable number of cattle, sheep, and horses, and live very cleanly. The Belu-daban pass, which Kozloff followed on his way across the Karlyk-tagh, is 10,600 feet high, and another pass in the western part of the same mountains was found to be 9600 feet.

Leaving Hami on September 24, the expedition went to the Lukchun depression, taking the desert route, which is the worse of the two leading to the depression, but was not yet explored; and Kozloff, with one man only and two camels, made an excursion into the desert. It is stony desert which runs sloping from the Tian-shan to the Chol-tagh. The winds have blown away all the movable soil, and the whole is covered with table-like heights, from which a number of ravines run both ways, the watershed having but an altitude of 1000 feet above the sea-level. Low hills rise west and east. The work of the wind is extremely interesting in shaping the rocks into fantastic forms, and the imagination of the natives sees in those rocks ruins of mystical towns. It was this route that was followed by the fugitives from Hami to Lukchun during the Dungan insurrection, and the sufferings of the fugitives in the desert were terrible. The tamarisk and rushes are the characteristic representatives of vegetation in this desert, and in the animal world the antelope *kara-sulta* (*Gazella subgutturosa*);* of birds *Podoces Hendersoni* is a permanent inhabitant of the desert, and *Sylvia nana*, with a species of *Saxicola*, were temporary visitors. Many species of aquatic birds were seen on the shores of Shono-nor. At Lukchun the expedition found their true Cossack, Shestakoff, who had stayed there for two years, making those most valuable barometrical observations which will permit geodesists to determinate with great exactitude the level of this remarkable negative depression.

From Lukchun the expedition continued to move northwards through Urumchi and Manas to Zaisan, while Kozloff took an eastern route, *viâ* Guchen and across the Saur ridge of the Altai. The Tian-shan being already covered with snow, it was crossed in its lower part (Pass Gochan, 7500 feet), where it has a width of no more than 35 miles, and a most beautiful view of the snow-covered Jungarian plain was seen from its summit. Guchen (altitude 3200 feet, population two thousand five hundred) is very picturesque, being situated some 30 miles from the northern foot of the Tian-shan, where some Chinese and Chantus live, supplying the town with timber for export. In the company of smugglers, Kozloff crossed the last mountain tracts which separated him from the Russian frontier, thus visiting the valley of the Urungu and the Kobbe Sans which was visited by Prjevalsky during his second journey, and are the dwelling-places of the wild camel, the wild horse, the *kulang*, and perhaps, also, of some unknown tribe of men who are said to be met with in this desert, especially in the neighbourhood of the stone monument Khan Obo. These *Kyz-kiyks* (wild men) are described by the natives as in size about the same as their own; a short wool, similar to the fur of a young camel, covers the whole body; black hair falling to the shoulders; dark eyes; body short, but legs rather long. They feed on roots growing in the desert; move about always in pairs; look severe and hard; emit sounds when angry, or as a calling signal; when

* All zoological names are those given by P. K. Kozloff.

pursued, shout pretty loudly, and a whistling sound is noticeable in that cry; run very rapidly; walk rapidly too, putting the feet wide apart. The Kirghizes whom Kozloff questioned said that they had been in possession of living *Kyz-kiyks*, chiefly females *enceinte*. They kept them for two or three days, offering them meat and cakes; but they refused food, simply crossing the hands on the breast and twinkling with the eyes. When looked at for some time, the *Kyz-kiyk* became angry, turned his head, and made his hair bristle. When they were left free, they at once took to the desert, a comrade making his appearance in the neighbourhood where he concealed himself. The Kirghizes added that *Kyz-kiyks* could be caught in winter, but never are seen in summer. "Personally," Kozloff writes, "I do not much trust to the rich imagination of the nomads, but I was interested in that communication, and give it that other travellers might verify if there is something in that information concerning the mythical problematic inhabitants of the Kobbe sands."

From the Urungu valley Kozloff went to lake Botogan-kul, which communicates with the Ulungur. Then he crossed the Salburty range, which belongs to the system of the Altai, and next the main range Saur, and entered the Russian village, Kenderlyk, from which a *troika* of post-horses brought him to Zaisan. The main body of the expedition, under Roborovsky, was already there.

Another 1200 miles were thus surveyed by Kozloff during these three excursions, which he made independently from the main body of the expedition.

P. K.

THE MONTHLY RECORD.

THE SOCIETY.

Royal Medals and other Awards for 1897.—The annual honours conferred by the Society on distinguished explorers and geographers have been this year awarded as follows:—the Founder's Medal to M. P. Semenoff, vice-president of the Russian Geographical Society, for his early exploration of the Tian Shan range, for his important contribution to geography in the form of addenda to Ritter's 'Asia,' and especially for his long-continued efforts in promoting Russian exploration in Central Asia. The Patron's or Victoria Medal to Dr. George M. Dawson, C.M.G., F.R.S., director of the Geological Survey of Canada, for the geographical exploration carried out by him in the North-West Territories, in Alaska, and in other parts of Canada, during his long connection with the Dominion Geological Survey; and for the encouragement he has given to geographical work on the part of the survey officers. The Murchison Grant has been awarded to Lieut. Seymour Vandeleur, D.S.O., for his careful surveys during journeys and active service in Somaliland, in Uganda, Unyoro, and on the upper Nile, and in the Niger region; the Back Grant to Lieut. Ryder, of the Danish Navy, for his explorations and discoveries in East Greenland in 1891 and subsequent years; the Gill Memorial to Mr. C. E. Douglas, for his persistent explorations during twenty-one years of the difficult region of forests and gorges on the western slopes of the New

Zealand Alps; the Cuthbert Peek Grant to Dr. Thorvald Thoroddsen, for his continuous and extensive explorations in Iceland since 1882, and for his valuable contributions to the physical geography and geology of the island. The three honorary corresponding members chosen are—Prof. G. Dalla Vedova, secretary of the Italian Geographical Society; Baron E. von Toll, the Russian explorer of the New Siberian islands; and Captain Otto Irminger, secretary of the Danish Geographical Society.

EUROPE.

The Lincolnshire Fens.—Books on the regional geography of England are so rare, that it is somewhat surprising to find two, both of considerable size and no small value, devoted to the fen country—the part of England perhaps least likely to evoke the enthusiasm of its inhabitants for their home. Miller and Skertchley's treatise on the Fenland deals with the whole district, Mr. Wheeler's work,* a new edition of which has just been issued, is more restricted in its scope and more practical in its aim. The reclamation of the fens is, from the geographical point of view, one of the most important chapters in the history of England, and in no part of the British Islands can one see so well as in the fen country the double influences of Nature on Man and Man on Nature, the elucidation of which is the greatest aim of geographical science. Mr. Wheeler's object in this book is to collect together all the available data for the history of the reclamation of the Lincolnshire fens. The history of the fenland is traced from the earliest times, when it was a waste watery country inhabited only by a few fishers and fowlers, through the Norman period, when it swarmed with churches and monasteries built on every island, and agriculture began to be introduced. The protection of the country against floods and the regulation of the waterways began as early as 1142 with the great sluice at Boston. The assistance of Dutch engineers was called in in the seventeenth century, and steady reclamation has since been carried on until the face of the country has been entirely changed, the meres drained, and the marshes reduced to trifling proportions. The legislation on the subject of the fenland, both local and national, is referred to in great detail, and full particulars are given of the engineering works by which the reclamation was carried out. Maps, of a somewhat rough kind, are given showing the system of drainage in each district, and described in a satisfactory manner. Special chapters are devoted to the agriculture, waterways, roads and railways, geology and water-supply, and natural history and products, climatology and health. In the last chapter the curious fact is noted that opium-eating is prevalent amongst the labouring classes, a legacy from the time before the introduction of quinine, when it was taken as a preventive of ague. A series of valuable appendices give (1) names of places, many of which have passed out of use; (2) a classified list of books on the fenland; (3) the titles of all Acts of Parliament relating to the district; (4) glossary of terms and local words of the fenland; (5) statistics of rainfall and climate; (6) levels; (7) borings; and (8) list of "sewers." The data are put together in a systematic and business-like way; and, in default of purely geographical memoirs, such local descriptions are of great value, promising much aid in any systematic geographical study of the country which may subsequently be undertaken.

* 'A History of the Fens of South Lincolnshire, being a description of the rivers Witham and Welland and their estuary, and an account of the reclamation, drainage, and enclosure of the fens adjacent thereto.' By W. H. Wheeler. 2nd edit. [1897.] Boston: J. M. Newcomb.

The Old Beds of the Adour.—M. C. Duffart contributes an interesting paper on the mouths and the old beds of the Adour river before the sixteenth century, to the *Bulletin* of the Bordeaux Geographical Society (February, 1897). Peculiar interest attaches to this river on account of its apparent relation to Cap Breton Deep, a narrow and immensely deep gully running in from the ocean close to the coast of France. M. Duffart does not touch on this part of the problem, however, but concerns himself with tracing the successive alterations produced by encroaching sand-dunes from the tenth century, when the mouth was close to Cap Breton, to the year 1578, when, on October 28, the river was diverted at Bayonne from its northern course behind the wall of dunes, and made to flow into the sea due west. He considers that there were three great periods of the movement of dunes: (1) The formation in prehistoric times of dunes on the great islands which then existed west of the ancient delta of the Adour. These now form the first series of old continental dunes far inland. (2) The formation of dunes during the Middle Ages up to the tenth century, consequent on the destruction of forests on the *landes* and the first old continental dunes. These gave rise to the southern lagoons of the *landes*, and turned the course of the Adour northwards parallel to the coast; they form the second series of old continental dunes. (3) The movement of modern dunes from the fourteenth to the sixteenth centuries. This led to the formation of the northern lagoons of the *landes* from the Etang de Léon to the estuary of the Gironde. Islands existed along this coast, which is now unbroken and uniform for more than 100 miles (save for the basin of Arcachon), as late as the eighteenth century.

Snow in the Austrian Alps.—Dr. Anton Swarowsky lately read a paper before the Austrian section of the German and Austrian Alpine Club on the facts observed with reference to the snow-layer in the Austrian Alps. A three years' mean, deduced from a full series of observations at the chief stations, gives the duration of the winter covering of snow below 3500 feet, as 150 days in the Northern Alps (from the end of November to the end of April), 115 days in the Central, and 110 days in the Southern Alps. The duration of the snow-layer is determined, in particular cases, not only by the temperature, but also by the quantity of the snowfall. Of the stations at the foot of the Northern Alps, Vienna retains the snow-covering for the shortest time—39 days—its total thickness being there about 3 feet. The smallest average amount observed was at Krems, on the Danube, where it did not quite reach 2 feet; whilst the Salzkammergut, and particularly Aussee, showed the greatest amount of snow, a mean of no less than 16 feet being recorded. The observations with regard to the water-equivalent of snow are of special interest. Whereas the volumetric ratio of old snow to the water derived from it has been previously taken to be as 4 : 1, the observations proved it to be as 2·5 : 1, or even 2 : 1. The value of the results is heightened by the large number of individual observations. The densest layer of winter snow—already possessing the character of "firn"—does not occur at the bottom of all, but, after a certain increase in density of the individual layers from above downwards, the lowest layers of all again show a diminution of density.

ASIA.

Russian Expedition to Manchuria.—So far as may be judged from the news about the expedition which was sent out this year to Manchuria, under Messrs. Anert and Komaroff, its results are very interesting. From the Cossack village Poltavskaya, the expedition crossed Manchuria to the village Mikhailo-Semenovskoye (on the eastern slope of the little Kinghan, above the junction of the Amur with the Sungari), thus crossing the Manchu mountain region, then the Manchu-Mongol plains and the Sungari-Amur lowlands. The general aspect

of the region, so far as it was ascertained by the expedition, is as follows:—The mountain region of Manchuria stretches from the north-east to the south-west, containing the little Khinghan range (Dousse-alin) in the north, and the Liao-Tong (Leao-tong) peninsula in the south. This mountain range is separated on the east by the Khangka-Usuri lowlands from the coast-range Sikhota-alin, and on the west by the Manchu-Mongol low plain from the Great Khingan (the border range of the high plateau). "Both the climate and the vegetation of the middle portion of Chinese Manchuria," the Russian Geographical Society's Report continues, "are, all taken, similar to the climate and vegetation of the Amur portion of that region. The southern winds of the East Asia monsoon bring to it a mass of moisture, and result in a regular period of rains, attaining their maximum in August. Frosts begin already at the beginning of September, and continue till April. The granitic nucleus of the Manchurian mountains gives origin to the sands and impermeable clays, upon which cornfields are scattered, the most fertile of them being on the surface of basaltic lavas. The virgin forests of Manchuria consist of deciduous trees, but they are of no use for culture, which is limited to low valleys. Chinese emigrants have peopled nearly the whole of that region, Manchus occupying now but the northern portions of it."

Formation of a New Rapid on the Yang-tse.—Mr. Consul Bourne has sent us details respecting the formation, through a landslip, of a new rapid on the Yang-tse, which is of sufficient importance to seriously impede navigation. It is situated in 30° 54½′ north latitude, and in about 109° 16′ east longitude. The landslip appears to have been brought about by a lengthened period of rain. It is necessary to unload the cargoes of all junks which pass the rapid, and even when empty they can do so only with the greatest difficulty. When the river was at its lowest the ascent of the rapid was quite impossible.

AFRICA.

Recently published Documents on Sierra Leone.—The origin of the name of this English settlement is not yet a perfectly ascertained point. M. Elisée Reclus rightly declares (in his *Nouvelle Géographie Universelle*) to be incomprehensible why the official English name is half Spanish (*Sierra*; why should it be Spanish?) and half Italian (*Leone*;* why should it be Italian?). However, M. Reclus presents as the correct Portuguese form "Serra-Leôn," while the 'Encyclopædia Britannica' assures us that it is "Sierra Leona." As a matter of fact, "Serra Leôa," meaning the "Lioness mountain," is the right Portuguese name given, in the middle of the sixteenth century, to a mountainous peninsula on the west coast of Africa. M. Reclus, and many recent writers, wonder if the cause of such a name were the vague resemblance of the mountainous mass to a recumbent lion (Cantino represents it thus on his 1502 map, and this is the opinion adopted recently by Mr. A. H. Keane); or if Pedro de Cintra actually saw there a lion; or, again, if it were—according to Cadamosto—the thunderstorms reverberated by the littoral mountains that suggested the roaring of lions.† A manuscript of the sixteenth century, recently published in Lisbon, seems to settle this point, as we have in it the opinion of the discoverer Pedro de Cintra himself. In his 'Esmeraldo de Situ orbis' (liv.] i. cap. 33, p. 57), written in 1505, Duarte Pacheco Pereira,

* Ramusio writes *Serra* Liona, the word *serra* being, in Portuguese, a feminine noun.

† The pilot of Villa do Conde, whose narrative (1551 or 1552) Ramusio published, speaks of the thundering storms of Serra Leôa, but does not say that its name was derived therefrom.

while giving a very interesting description of Serra Leôa, its geographical position and relations with Rio-Grande and the Cape Verde islands, says, "Many think that this land was called Serra Lyoa on account of the existence of lions, but this is not true, for Pedro de Sintra, who, by the command of the *Infante* Dom Henrique, whose knight he was, discovered it, called it 'Lioness' for its rugged and wild appearance (*aspera e brava*), and not for any other reason; this must be taken for certain, as he himself told it to me." In the same chapter Duarte Pacheco gives some interesting information: "The natives (Boulooes [= Bullom, Bolama]) are only occasionally cannibals. There is gold in the country (especially at Coya), where the natives buy it for salt, and then exchange it to the white men for brass rings, barber basins, and red cotton goods. Elephants are numerous, . . . and wild men of the sort the ancients called Satyrs, entirely covered with long hair, and altogether like men in their ways, with the only difference that they scream instead of speaking when they are attacked, and live in the most recondite parts of the mountains [probably the gorilla, found at present further to the east]. . . . 12 or 15 leagues inland the Scuzos [Soso = Suzos] have much iron, which they bring to Serra Lyoa and other localities. . . ." Camões called Serra Leôa "very rugged" (*asperrima*),* but Duarte Pacheco Pereira calls the region handsome (*fermosa*). King Dom Manuel had then a fort on the river Mitombo (Rokelle). Captain Alvares de Almada, who explored the country in 1580, and wrote a very flattering memoir† on it, tried, about 1594, to establish a colony in Serra Leôa, which then enjoyed such a good reputation, or was so attractive on account of its picturesqueness, that the Portuguese governor of the island of Sant' Yago (Cape Verde) dissuaded Alvarez d'Almada from his scheme, for fear all the inhabitants of the island should go over with him to the African continent. The territories of Serra Leôa were, however, the object of a special royal grant in 1606, and of some subsequent legislation. Dr. Sousa Viterbo, the well-known Portuguese historian, has just published‡ the interesting documents he, for the first time, brought to light from the Lisbon Archives of Torre do Tombo (*Chancellaria de Dom Philippe II. Doaçoẽs*, liv. 13, fol. 236). By a royal charter Philippe II. of Portugal (III. of Spain) granted the lands between Rio de Cassi (Scarcies), where ended the territories granted by another Portuguese royal chart, and Cabo das Palmas (being 130 leagues along the sea-coast, with all the adjacent islands) to Pedro Alvares Pereira and his successors. By that concession were vested on Pedro Alvares Pereira all administrative and judicial powers, together with the monopoly of all waterfalls, salt or other mines. He had the right to conquer and subdue all the native chiefs and races of the hinterland, the exclusive rights of commerce in the ports and rivers, and that of establishing settlements or even towns (not less, says the chart, than 6 leagues apart of each other), where, during the first fifteen years, he was obliged to have four hundred men, two hundred of them married, and accompanied by their wives and children, some of the colonists being agriculturists, and thirty masters in different crafts, with one physician and two priests. Alvares Pereira had, moreover, to furnish the necessary ships for the commerce, and to build one church, three castles, in stone (one of

* "Deixando a Serra asperrima Leôa," *Lusiadas*, cant. v., est. 12. Sir Richard Burton, under the influence of Cadamosto, "englished:" "Leaving the rugged range where lions roar," but declares (without knowing Pacheco Pereira's *Esmeraldo*) that lions probably never existed there ('Camœns, a Commentary,' vol. ii. p. 616, 1881).

† 'Tratado breve dos Rios de Guiné do Cabo Verde,' etc. MS. of 1594 only published on 1733 and 1841 with a map.

‡ 'Os Portuguezes e o Gentio,' Coimbra, 1896.

which in the port of Serra Leôa), and all the necessary fortifications against the natives and the pirates. The charter establishes the taxes he had to pay, including one-tenth of all incomes to the order of Christ and, to the king, the value of one fish in every twenty caught beyond 20 leagues from the coast. Pedro Alvares Pereira had the right to introduce annually forty-eight slaves in Lisbon free from duty, and only to pay 1600 *reis* for each one exceeding that number, besides the right to employ slave labour in his ships. All the first explorers agree in considering Serra Leôa a charming place. The Portuguese Pimenteis say in their Roteiros (of the seventeenth and eighteenth centuries) that it is "the healthiest spot in all Guinea." Dr. Sousa Viterbo publishes some documents concerning the laws against the Portuguese who chose to live with the African natives, adopting their costumes, superstitions, and even their dresses and tattooing. These especially selected Serra Leôa. This locality is, however, now well known as "the white man's grave."

Explorations in the Congo Basin.—The Congo State officers continue to reduce the area of unexplored country within the Congo basin by journeys of reconnaissance in the vicinity of their posts. During the latter months of 1896, Lieut. Brasseur, accompanied by Lieut. Cerckel, completed the exploration of both the western and eastern branches of the upper Congo, and his journey is described in the *Mouvement Géographique*, 1897, Nos. 11–13. Starting from the station of Lofoi, in Katanga, the explorers reached the Lualaba at Shimaloa's village, where it was crossed by Le Marinel in 1891, and proceeded down its level and swampy valley as far as its junction with the Luapula. Cameron's report of a series of small lakes along the course of the river appears to be entirely confirmed, but it seems that they almost all lie off the direct course of the stream, forming as it were backwaters connected with the latter by channels. Lake Kissali (seen from a distance by Cameron in 1874) is, according to the maps given in the *Mouvement*, the only exception to this rule, as it is traversed by the main stream, and receives also the Lufira, or Lufila, on its south shore. This was known to Livingstone, who was the first to speak of the lake, so far back as 1868. The whole course of the Lualaba below Shimaloa is open to navigation. Its valley is generally narrow, being bordered for a considerable distance by the Mitumba *massif* on the south-east. The Luapula was ascended by Lieut. Brasseur along its left bank. It is broken by a succession of rapids, which begin soon after its exit from Mweru. At one point there is a fall of over 60 feet (that of Kanke). Lower down the river flows through a perfect chaos of mountains, which recalls the scenery of the neighbourhood of the Juo falls on the Lufira, being part of the same line of high ground. M. Wauters considers that Lieut. Brasseur's exploration confirms his idea (based on geological grounds, but coinciding with Cameron's previous statement) that the western branch is the true upper course of the Congo. Like M. Cornet, he holds that the Lualaba or Kamolondo valley was formerly occupied by a lake, which has been drained through the narrow pass discovered by Captain Hinde and Mr. Mohun. Officers of the Congo State (Lieuts. Lange and Long) have also, like the German Captain Ramsay, ascended the Rusizi river north of Tanganyika, and explored the east shore of Lake Kivu, where they have founded two stations (*Mouvement Géographique*, 1897, No. 8, with sketch-map). The Rusizi forms a succession of rapids, the most important fall being that of Pembo at its exit from the lake, where the mountains confine the stream within a narrow gorge, rising on the east side, in the peak of Dagoro, to a height of nearly 8000 feet. The western shore of Lake Kivu is still unsurveyed. The third number of the *Mouvement Géographique* for 1897 contains the account of an exploration by M. Stache in the region between the Kassai and Sankuru rivers. After leaving the territory of the Bashilele, who dwell near the confluence of the two rivers, the traveller reached the Bakele, a

tribe which has borne the character of being hostile to Europeans, but which, though at first suspicious, allowed M. Stache to pass. Their most powerful chief is named Mianu. The people show many resemblances to the Bakuba, are tall and well made, and dwell in populous aggregations of villages. The farthest point reached was Galikoko, apparently in the Bakuba country. M. Stache is an agent of the Société Belge du Haut Congo.

Exploration of the Malagarazi.—The *Deutsches Kolonialblatt* for February 15 last contains the account of an exploration of the lower course of the Malagarazi by Lieut. Fonck, who was sent for that object by Captain Ramsay after the establishment of the German station at Ujiji. Although the route from Tabora to Ujiji passes at but a small distance north of this part of the stream, no traveller had made a complete examination of its course, whilst such an examination was needed in order to prove whether it could be utilized as a means of communication between Ujiji and the salt wells on the Ruchugi, the output of which has lately reached large proportions. The boats in which Lieut. Fonck started up the stream from the head of its delta had soon to be left behind owing to obstructions to navigation, the mountains closing in on either side, and the bed of the river being strewn with rocks, between which the water flowed with great rapidity. Higher up two considerable falls were reached, the second of the two having a perpendicular height of over 50 feet. The banks were in great part uninhabited, and covered with jungle, traversed only by hippopotamus paths, so that the attempt to follow the river continuously was abandoned; but the number of rapids seen proved that in the dry season navigation would be possible only for short distances, whilst even at high water many difficulties would be met with. The various channels of the delta are shallow and obstructed with sandbanks, so that they could be navigated by craft of any size only in the rains.

African Trade.—Recent Consular Reports deal with the trade of Uganda, Suakin, and Beira respectively during the year 1896. Writing from Uganda, Mr. Berkeley reports an increase both in the bulk of trade and also in the demand for better-class goods, such as manufactured clothing, household utensils, etc. The export trade still consists exclusively of ivory, but the Waganda are becoming alive to the importance of fostering native products, such as coffee, rice, etc. The trade of Kavirondo (which centres at Mumia's) has likewise increased, thanks to the pacification of the country by Mr. Hobley, and caravans now go northwards beyond Elgon and into Turkana. In Uganda various efforts have been made to develop local resources. Skilled labour has been introduced for the working of saw-mills, with a view to the improvement of the native industry of carpentry. Practical experiments in cultivation have been made at Kampala, the best results having been obtained with rice, cotton, oil-seeds, and European vegetables. A thriving plantation of over 1000 coffee seedlings has been already formed by the agent of a European firm. At Suakin a decrease in every branch of trade is announced, owing to the interruption of trade routes, due to the expedition against the Dervishes. The decrease in the importation of grain was, however, due to the success attending the cultivation of the Baraka delta during the preceding season. Gum still remains the principal article of export. An exceptionally good harvest was secured in the Tokar district in 1896, consisting chiefly of durra and dukhn. At Beira the trade during 1896 showed a considerable increase as compared with former years, due partly to increased landing facilities, the inauguration of agricultural enterprises, etc., and partly to temporary causes, such as railway construction and the introduction of troops. Scarcity of native labour, heavy import duties, and the want of a direct and regular steamship connection with England are mentioned as some of the principal hindrances to trade. The Messageries

Maritimes Company has started a regular monthly service between Delagoa bay and Beira, which is much patronized. The importance of British interests is, however, shown by the fact that most of the trade cargoes are imported in British vessels, the landing and railway companies are British, and the language employed in business is English. The British population is 120, second only to that of Portuguese nationality.

Surveys in German East Africa.—Extensive surveys have lately been carried out in the region of the lower Rufiji by Robert Hans Schmidt, of Vienna, acting under the orders of the government of German East Africa. Descending the stream in canoes, Herr Schmidt laid down on a map the various arms of the delta, afterwards exploring the little-known but picturesque mountains of Alatunibi, between the river and Kilwa. North of the Rufiji he discovered the small lake Lue, or Bunju, and fixed the position of the hot springs of Nyunguni. His map is based on forty astronomically fixed positions, and he has taken many altitudes and made extensive collections. Although the region bears a bad name for unhealthiness, Herr Schmidt enjoyed good health throughout. He is engaged in preparations for a new expedition, having for its object the determination of the boundaries of the various provinces of German East Africa, and the investigation of the best route to Lake Nyasa, especially with regard to the navigability of the Rufiji, Ulanga, and Ruaha.

M. Gentil's Mission to the Shari Basin.—Further news of this expedition (*Journal*, vol. viii. p. 517) is published in the *Revue Française* for April. M. Gentil is said to have reached the Nana, a southern tributary of the Shari, and to have transported the sections of his steamer to a station founded on its banks. A preliminary examination of the river indicated its suitability as a navigable channel towards the Shari and Lake Chad.

AUSTRALASIA AND OCEANIC ISLANDS.

The Atoll of Funafuti.—The local committee of the "Funafuti Coral Reef Boring Expedition" of the Royal Society, in charge of Prof. Sollas, suggested to the trustees of the Australian museum that one of their officers should be attached to the expedition, and Mr. Charles Hedley accordingly joined H.M.S. *Penguin* at Sydney in May, 1896. A general account of Mr. Hedley's observations, with special reports on rock-specimens and birds collected, is published by the museum (Memoir III.). Mr. Hedley's geological results cannot be better summarized than in his own words: "(*a*) An elevation of Funafuti by at least 4 feet is proved by dead sub-fossil reef-corals in the position of life near high water-mark. (*b*) Darwin's theory of coral reefs, as opposed to Murray's, is favoured by these facts:—Firstly, soundings show the atoll to be planted, not on a bank, but on a cone; secondly, they also show it girdled by a precipitous submarine cliff, explicable only on the subsidence theory; thirdly, our observations and the experience of residents agree that the lagoon is filling up, whereas Murray demands its excavation. (*c*) A peripheral growth at present level is indicated on both sides of the islets." Some notes on the climate indicate that its chief feature is constant humidity—so great that, for example, the drying of plant specimens in blotting-paper was hopeless, and botanical inquiry was therefore restricted to observations on plants used by the natives. The final section of the memoir, on the population, gives some account of the history of the people, their language, religion, and customs. Sixty years ago about thirty islets contained over 3000 people; unknown and terrible diseases, introduced by white men, had reduced this number to 160 in 1870, but an increase to 200 had taken place in 1882, and to 250 in 1896.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

The Cooling of the Earth as a Cause of Evolution.—The *Comptes Rendus* contain some further speculations by M. R. Quinton on the origin of life on the globe, and its successive stages under the gradual cooling at the surface. Life began, according to M. Quinton, under conditions of high temperature, and all animals reproduced oviparously. As the temperature became lower, certain species adapted themselves to the conditions; these are now represented by the *cold-blooded* animals. Others, again, did not so adapt themselves, and found that their eggs failed to hatch, unless "artificially" kept warm and supplied with food; hence the development of brooding animals, marsupials, mammals, etc.; the conditions requiring in the young increased heat and rate of growth to make up for and remove as soon as possible the disadvantage of great cooling surface compared with mass in the young individual. The continued cooling is thus a permanently active cause of evolution; without it neither bird nor mammal would have made its appearance, and the course of evolution is to be traced by a classification depending, not on community of habit or of habitat, but on similarity in mode of reproduction.

Evaporation and Drainage on Large Land Surfaces.—The fifth number of the fifth volume of the *Geographische Abhandlungen*, edited by Prof. Penck, just issued, contains two important papers, one on the rainfall and drainage of Bohemia by Dr. Vasa Ruvarac, and one really a discussion of Dr. Ruvarac's paper by Prof. Penck himself, on the general question of the relations between precipitation, evaporation, absorption, and drainage over closed areas of fair size, like Bohemia. As in the case of the extensive reports on the basin of the Oder, noticed in a recent number of the *Journal*, the bulk of the observations owe their existence to the inconvenience caused by floods and droughts, dating chiefly from the early sixties, when their connection with extensive deforestation of the mountain slopes first became disagreeably obvious. Dr. Ruvarac gives carefully compiled tables, based on data which he subjects to most rigorous examination, showing annual values of the following quantities: Water-level of the Elbe at Tetschen; date of formation and disappearance of ice at Leitmeritz, Aussig, and Tetschen; amount of water delivered by the Elbe at Tetschen, by the Moldau at Karolinenthal, the Little Elbe at Brandeis, and the Eger at Laun; and the rainfall of Bohemia. The tables form another gratifying illustration of the increasing use of the method so successfully employed by Hann and Penck—of using the mean of a long period of observations merely as a starting-point for close examination of monthly or annual variations by approximative deductive methods, instead of the premature rigorous treatment so much in vogue a few years ago, when the reaction from the old average-worship first began. Prof. Penck's paper is a masterly application of the same method in more extended form to the problem of making out the details of a balance-sheet which may be summarized as follows: Drainage = precipitation − evaporation. To get a result in this simple form it is necessary to deal with a lengthened period, or, if this is not possible, to allow for certain intromissions with the capital account in the form of accumulations of or drainage from ground or surface water. There is, however, the further condition that these two latter are also ultimately equal. In Bohemia, the greater part of the 35·3 cubic kilometres of water precipitated annually is removed by evaporation, the amount being 25·5 cubic kilometres, equivalent to a rainfall of 500 mm. The heat required for this evaporation would melt an ice-sheet 3·75 metres in thickness, and corresponds to about 18 per cent. of the total radiant heat received under clear-sky conditions. The variations in amount of evaporation depend much more on variations of rainfall than of

temperature. The more rain falls in Bohemia the more water is removed by evaporation. Leaving wind out of account, the evaporation at any place depends on the amount of heat received—a function of its latitude which can be worked out with the help of Angot's radiation constants, giving the maximum possible evaporation. But on a land surface, evaporation can only go on when rain has fallen, and the more copious and frequent the rainfall within the ascertained limit, the greater the evaporation. The most favourable case is where the distribution of the rainfall corresponds to the annual variation of solar intensity, and it follows that two places in the same latitude with equal annual rainfall may give very different values for the amount of evaporation, while in a region with a definite type of rainfall-distribution the evaporation varies with the amount of rain. It is thus possible to find for any district limiting values of rainfall and evaporation which are equal, and if the rainfall at any time falls below this value for a long-enough period, there is no water to be carried off by drainage. Prof. Penck obtains a value between 280 and 350 mm. for the whole Elbe basin in Bohemia—370 to 400 mm. for the Moldau basin, and 260 mm. for the remainder. The final and most important result is that the amount of water removed by drainage is proportional, not to the total rainfall, but to the excess above the limiting value equivalent to evaporation. The effect of increased temperature is much smaller, a change of 1·6° Fahr. in the annual mean corresponding to an evaporation of 19 mm., or a rainfall of 36 to 46 mm. The relation between increase of rainfall and increase of drainage, or the "drainage-factor," varies for short periods between 22·5 and 31·4 per cent. in the different parts of Bohemia, depending on different conditions of the soil. The factor is smallest for an impermeable soil, because the water remains on the surface and is more exposed to evaporation, but on a sloping surface the water is carried off rapidly, and the factor increases with the rainfall. To sum up. There are thus five quantities to be taken into account: (1) the total precipitation, n; (2) the limiting value of rainfall equivalent to evaporation, n_e; (3) the relation between increase of precipitation and evaporation, γ; (4) the departures from mean temperature, t, and the relation between variations of temperature and of drainage, α; (5) the quantity of water "in hand" at the beginning of the period considered, s', and the amount added to or taken from that stock, s''. The relation between these and the total water removed by drainage can be simply expressed by $A = (n - n_e)\gamma - t\alpha + s' - s''$. We heartily commend this paper to the careful consideration of engineers and agriculturists as well as geographers.

Soundings and Temperature Observations in the Færoe Channel.—The Hydrographic Department of the Admiralty has just issued a report by Captain Moore of the work done by H.M.S. *Research* in the Færoe channel during August of last year. A large number of temperature observations were made at stations visited by H.M.S. *Jackal* in 1893–94, and by H.M.S. *Knight-Errant* in earlier years, and particulars of these are given in the report, their discussion and the examination of numerous water-samples collected being left in the hands of the Fishery Board for Scotland, from whom we may expect to hear more. The work of H.M.S. *Research* in this difficult region is of the greatest possible value, and especially at the present time, when it forms part of a connecting link between the extensive survey of the North Atlantic being carried out by Mr. H. N. Dickson, and the simultaneous work of Prof. Pettersson and others off the west coast of Europe. Captain Moore's observations bring these two undertakings into close relation with one another, thereby greatly increasing the value of each, and they at the same time afford an opportunity of comparing the physical conditions of the water in a region like the Færoe channel at the same period of different years.

We look forward with much interest to the discussion of them in the pages of the Fishery Board Report, and we hope that H.M.S. *Research* will again help to complete the system of observations during this season. In an addendum to his report, Captain Moore gives a short discussion of the relative merits of Negretti and Zambra's and Cary's thermometers for deep-sea work. The conclusion arrived at is that the reversible thermometer in the Scottish frame is the more accurate, but that it is unsuitable for surveying work for various reasons, all connected with the messenger. It would seem that the objections to the messenger system are only valid where the loss of a set of observations involves much delay by reason of the great depth, precisely the conditions where the old Magnaghi frame is at its best, and the Scottish frame least necessary. Greater difficulties in the use of the reversing thermometer are not referred to by Captain Moore, viz. the slight variation of the point at which the column of mercury breaks, which seems inseparable from these instruments—even the best will *sometimes* give a reading considerably out—and the practical difficulty of getting a reversing arrangement easily "set off" when required, but certain not to do so when not required. We are glad to learn that, in the hands of the Danish oceanographers, the improved form devised by Dr. Martin Knudsen gives excellent results, but we hope before long to see some modification of the thermophone, or similar electrical instrument, which shall once for all dispose of all the clumsy apparatus at present in use.

Latitude and Longitude by the Gyroscope.—M. E. Durant-Gréville describes in the *Revue Scientifique* for March 27 an ingenious arrangement of two gyroscopes, by which the latitude and longitude of a ship or balloon may be obtained at any time and in any weather, whether the sky is clear or not. The gyroscopes, which it does not appear that the author has constructed or tested, would be kept in motion by an electric arrangement. That for longitude would be started with its axis parallel to the axis of the Earth, and, being suspended by a torsionless string, would give the latitude at any moment by reading the angle between the suspending (vertical) string and the heavy ring which keeps parallel to the plane of the equator. The gyroscope for longitude has to be set in motion with its axis in a plane parallel to that of the prime meridian; it is read in conjunction with the latitude instrument, and the result reduced by reference to a chronometer to allow for the rotation of the Earth. Whether this extremely ingenious application of the gyroscope will be practically useful remains to be proved.

GENERAL.

The Bishop of London on Regional Geography.—At the annual meeting of the London University Extension Society, held on April 3, in the Mansion House, the Lord Mayor in the chair, the Bishop of London (Dr. Creighton) gave an address entitled "The Study of a Country." He acknowledged that the title was vague and not fully satisfactory, but he wished to imply by it the study of our surroundings as a whole in all their natural complexity. As a rule the tendency of study was to abstract one aspect of a question from the others with which it was combined in nature, and, by concentrating intellectual attention on the artificially simplified problem, to destroy or discourage the faculty of mental alertness. He urged the importance of mental alertness in the affairs of practical life, and chose this title, "The Study of a Country," as a nucleus around which any knowledge one might acquire could be crystallized. In every country he recognized some sort of individuality, which, existent in the forms of its scenery, became impressed upon the character of its people. Familiarity dulled one's mental alertness to such an extent that the characteristic features of one's native country were very apt to pass unnoticed. The bishop stated that what had opened his eyes

to the characteristic beauty of English scenery, and to the causes which had created English life, was a journey in Russia. In Russia he realized what it was to live in the midst of the unbroken horizon of one vast unending plain. The feeling that one could go on for thousands of miles without perceptibly changing that horizon or the surrounding features produced a sense of monotony which could not be understood in England. The greatest countries of the world had always been small lands of varied scenery. Such lands were Palestine, Greece, Italy, and England. The great nations which had influenced the thought and civilization of the world, had all been formed under the same conditions, conditions in which the mind was stimulated to activity by the fact that it could so rapidly pass from one set of suggestions to another. The most remarkable natural feature in English scenery was its great variety and distinctness, and at the same time the beautiful gradations by which one form changed into another. Different aspects of a country appealed to different people, but each aspect, if pursued far enough, afforded abundant opportunities for the development of mental alertness. To one, the geology of a country opened up a vast system of possibilities of study, explaining the varieties of natural scenery and the causes of human aggregation and movement. To another, the study of architecture in one or all of its three great divisions, ecclesiastical, civil, and domestic, supplied the key to the life of the country. Through the architecture of buildings one could trace the march of historical events, and observe how the forms of buildings are dominated by the materials at the disposal of the architect. The variety and importance of English domestic architecture had not been at all realized. Even in a suburban walk it told much when the conventional modern rows of villas or flats gave way to a jumble of little old village houses, the inn, the general shop, and the smithy still visible, and pointing to the cause which had led the wave of population to approach and overflow the site. The bishop strongly urged on his audience the educational importance of the study of their native country.

The Third Cruise of the "Princess Alice."—Although the bulk of the work done by H.S.H. the Prince of Monaco, during his third season on the *Princess Alice*, is of a zoological tendency, it appears, from the account recently published in the *Comptes Rendus*, that results of great geographical interest have been obtained. The most important contribution to knowledge is probably the discovery of a bank near the Azores, to which the name *Princess Alice* has been given. This bank lies between 31° 28′ and 31° 41′ N. lat., and 37° 50′ and 38° W. long., in a north-west to south-east direction. Its circumference is about 40 geographical miles, the average depth below the surface 137 fathoms, rising in two summits to 104 and 41 fathoms, the bottom being rock and volcanic sand, with a rich and abundant fauna. Some interesting experiments were made with apparatus devised by Dr. J. Richard, the zoologist of the expedition, in particular a modification of Giesbricht's tow-net, and an arrangement for ascertaining whether the quantity of gases dissolved in sea-water is dependent on the pressure due to depth or not. The principle adopted in both cases is that of placing a "stop" on the sounding-line, letting it down to the depth at which it is desired to make the observation, and then allowing the instrument, previously "shut," to run down the line. On reaching the depth the instrument is "opened" by contact with the stop, and it can be shut again by sending a Rung messenger from the vessel. Samples of water were collected over mercury with an arrangement of this kind, at depths of 550 and 1475 fathoms, and the analyses confirm earlier work in the result that the amount of gases dissolved in sea-water is independent of the pressure.

The Russian Geographical Society.—At the meeting of this Society, February 3, the yearly report was read and the medals awarded. Of the three

expeditions which were sent out by the society for the observation of the eclipse of the sun, two were favoured with good weather. The work of pendulum observations, which has been prosecuted for years by the society, was continued by A. I. Vilkitsky in North-West Siberia (Tobolsk, Berezov, Obdorsk, and on the shores of Yugor strait), as well as by M. Witram on the Amur, at Vladivostok, and Hong Kong; while M. Moureau, from the St. Maur observatory, near Paris, continued to explore the magnetic anomaly in Central Russia. The study of the raised sea-beaches and the post-Tertiary deposits in North-West Russia, which it is proposed to carry on for several years, was begun last summer by L. N. Zvyeriatseff, in Esthonia, the St. Petersburg government, and Olonets; and the exploration of the Caucasian glaciers was continued by N. A. Bush and N. N. Schukin. They visited forty-eight glaciers, of which thirty had never been visited before, and determined the altitudes of their lower ends; moreover, the former explored the tributaries of the Kuban river, while the second made entomological collections and photographs of the visited localities. The chief expedition which was out last summer was engaged in the exploration of the Hissar mountains, in the Bukhara Khanate. It was under V. V. Lipsky and L. S. Barschevsky. These hilly tracts, where the three chief tributaries of the Amu—the Surkan, the Kafirnagan, and the Vaksh—as also the tributaries of the Zerafshan and the Kashka-daria, take their origin, were almost quite unknown. The heavy snow, which covered the mountains this year, rendered the work of the expedition extremely difficult; but still very interesting surveys were made, several glaciers were mapped, and collections, botanical, zoological, and geological, as well as many photographs, were brought in. Another perhaps even more important expedition, under a mining engineer, M. Anert, and a botanist, V. Komaroff, was at work in Manchuria. M. Slunin worked in the same summer on the coasts of the Sea of Okhotsk, making interesting botanical collections and ethnographical observations. A fifth expedition for collecting popular songs, with music, was at work in the governments of Tambov and Penza, under Th. M. Istomin and I. V. Nekrasoff; while S. G. Rybakoff was sent out to the provinces of Turgai and Uralsk, in order to study the songs and music of the Kirghizes. The ethnography and antiquities of Volhynia were studied by M. Th. Krivoshapkin; customary law, in Kostroma, by Th. I. Pokrovsky; the present conditions of the Telengutes, in the Altai region, by A. A. Kalacheff.—The Constantine medal of the Society was awarded to the geologist Th. N. Chernysheff, for his many years' work on the geography and geology of Russia; and Count Lütke's medal to I. B. Spindler, for his eighteen years' geodetical work. The large gold medals were awarded, by the section of ethnography, to E. I. Yakushkin, for his large work on customary law; and by the section of statistics, to Th. Th. Busse, for his researches into the maritime transport of peasant emigrants to Russian Manchuria. The Prjevalsky premium was awarded to V. I. Lipsky, for his explorations in the Hissar mountains. Small gold medals, to M. Moureau, for magnetical measurements; to G. A. Luboslavsky, for meteorological work; and to A. Makarenko, for ethnographical work. The Prjevalsky medal was awarded to D. A. Klements, for his journeys in South Siberia and Mongolia. Fifteen silver and twelve bronze medals were awarded for various works of less importance.

The Force of Tropical Rains.—Professor Dr. Wieser, of Vienna, has recently published the results of some observations on the effects of tropical rain-showers, made in Buitenzorg and in Egypt. The great fall of leaves observed after the occurrence of such showers is commonly supposed to be wholly and directly due to the violent impact of the raindrops, but this is found to be only a secondary cause inasmuch as the leaves are ready to drop in any case, and only require a slight

touch to detach them. Professor Wieser finds that the maximum amount of precipitation in such showers is at the rate of 0·04 mm. per second. We often read of drops 1 inch in diameter falling in tropical rains, but Professor Wieser never obtained any weighing more than 0·26 gram, and then only from very low clouds. The average weight was 0·06 to 0·08 gram, although 0·16 gram was not uncommon. It is remarkable that the rate of fall (7 metres per second) is independent of the size of the drops.

Proposed Anthropological Study of the North Pacific.—*Science* for March 19 states that the American Museum of Natural History is about to undertake a systematic study of the peoples inhabiting the shores of the North Pacific Ocean between the Amur river and the Columbia river, the whole funds for the purpose being supplied by Mr. Morris K. Jesup, president of the museum. The work in the field is expected to extend over six years, and it will be carried on simultaneously in Asia and America. The aim of the investigation is to collect the fullest anthropological data bearing on the problem of a former interchange of peoples between the old and the new world, and so to determine, if possible, whether the primitive American culture was indigenous or derived from Asia. As an indication of the difficulties of the problem, it is stated that ten languages and thirty-seven mutually unintelligible dialects are spoken between the Columbia river and Bering strait, while on the Asiatic side there are at least seven languages and ten distinct dialects, and investigations will probably bring still more to light. Such a project is extremely creditable to American private enterprise, and it is not undertaken a day too soon. The urgent need of similar systematic anthropological work in the Pacific islands has more than once been brought forward, and it is greatly to be wished that some wealthy friend of science would emulate Mr. Jesup by establishing a simultaneous study of the Pacific archipelagoes which might elucidate the problem of Asiatic intercourse with South America in early times.

Dr. Nansen.—After delivering his farewell lecture in England, Dr. Nansen proceeded to Paris, where he was presented to the President of the French Republic on March 26. In the evening of the same day he was welcomed by the Geographical Society at a special meeting held in his honour at the Trocadéro, the largest building in Paris, and received the enthusiastic applause of an audience of fully six thousand persons. M. Rambaud, Minister of Education, presided, and, after paying a warm tribute of admiration to the great explorer, performed the ceremony of investing him with the insignia of Commander of the Legion of Honour. Dr. Nansen's lecture, read in French, and illustrated with lantern views, was listened to with close attention. In Berlin the explorer met with a no less cordial reception. A meeting of the Geographical Society was held in his honour in Kroll's Theatre on April 3, the Imperial Chancellor and other representatives being present. In the absence, through ill health, of Major von Wissman, president of the Society, the chair was taken by Baron von Richthofen, vice-president. After the conclusion of the lecture, the announcement was made of the award to the explorer, on the part of the Emperor, of the great gold medal for science and art, and, on the part of the Geographical Society, of the gold Humboldt Medal, which has been previously bestowed on two explorers only, viz. Colonel Prjevalsky and Dr. John Murray. A banquet concluded the evening's ceremony. The following day Dr. Nansen lunched with the Emperor, and subsequently received an address of welcome from the city of Berlin. He afterwards proceeded to Copenhagen, where he was received and honoured by the king. Dr. Nansen has been presented by the British Government with a complete set of the *Challenger* publications, the only instance, we understand, in which such a presentation has been made to an individual.

OBITUARY.

Antoine d'Abbadie.

By E. G. Ravenstein.

Antoine Thompson d'Abbadie, best known to geographers for his extensive explorations in Abyssinia, died in Paris on March 21. He was born at Dublin on January 3, 1810, of a French father and an Irish mother, and had thus attained the ripe age of eighty-seven years. His parents removed to France in 1818, and he thus received a careful scientific education.

When quite a young man, in 1835, the French Academy sent him on a scientific mission to Brazil, the results of which were published in 'Observations relatives à la physique du globe faites au Brésil et en Ethiopie' (Paris, 1873).

In 1837, accompanied by his brother Arnauld, he started for Abyssinia, landing at Massawa in February, 1838. After a visit to Gondar he returned to France for a better outfit. He once more landed at Messawa in March, 1840, and between that date and October 4, 1848, when he finally left for Europe, he connected the place mentioned by what he terms an "expeditive triangulation" with Bonga, in Kafa, which he reached on November 30, 1843, having crossed the Abai on May 20. He crossed that river a second time on May 10, 1845, and visited the sources of the Gibe (Omo), which he looked upon as the true heart of the Nile. An attempt to reach Shoa from Zeila, on the gulf of Tajura, was frustrated, as he alleges, through the intrigues of Captain Haines. There can hardly be a doubt that d'Abbadie exercised such influence as he possessed in Abyssinia in favour of France and of the Roman Catholic missionaries, but it seems unfair to blame him for the expulsion of the Protestant missionaries from Adowa. Far more serious was the charge brought against d'Abbadie's veracity by Dr. Beke, himself an Abyssinian explorer of great merit, who, in 'An inquiry into M. d'Abbadie's journey to Kaffa' (London, 1850), expressed a belief that he had never been in that remote country. The literary quarrel thus originated culminated in Dr. Beke returning the gold medal which had been awarded him by the French Geographical Society. Time has done justice to M. d'Abbadie's high merits. His triangulation triumphantly stood the test applied to it by Captain Carter's surveys, made during the Abyssinian expedition, whilst more recent explorers of the countries lying to the south of the Abai have borne witness to the trustworthy character of the work done by him in this remote region. The topographical results of his explorations were published at Paris, 1860–73, in 'Géodesie d'Ethiopie,' which gives the three co-ordinates of 857 places and itineraries for 863 days of travel, and is illustrated by ten maps. Another work, 'Géographie de l'Ethiopie' (Paris, 1890), is mainly devoted to information derived from native sources, but only the first volume of it has been published. A description of 234 Ethiopian manuscripts collected by him will be found in 'Un Catalogue raisonné de MSS. éthiopiens' (Paris, 1859). In addition to smaller vocabularies, d'Abbadie compiled a 'Dictionnaire de la langue Amariñña' (Paris, 1881). He also prepared an edition of the 'Pastor of Hermes,' with a Latin version, 1860, and published numerous papers dealing with the geography of Abyssinia, Ethiopic coins, and ancient inscriptions.

Among his more recent labours should be mentioned the magnetic observations made by him in the course of several journeys to the Red Sea and the Levant ('Reconnaissances magnetiques,' Paris, 1890), and on earth-tremors produced by the beating of the waves upon the shore.

D'Abbadie was made a Knight of the Legion of Honour in 1850, elected a

member of the Academy of Sciences in 1867, and of the "Bureau des Longitudes" in 1878. He died the possessor of considerable wealth, and, subject to the life interest of his wife, bequeathed an estate in the Pyrenees, yielding 40,000 francs a year, to the Academy of Sciences, on condition of its publishing within fifty years a catalogue of half a million stars.

CORRESPONDENCE.

Drifting Sands.

I HAVE read with much interest Mr. Vaughan Cornish's paper "On the Formation of Sand-Dunes," which appeared in the *Geographical Journal* for March. As I have devoted many years to the study of psammology, and have already worked on the same lines as the author, and at some of the same places, viz. Poole Sand-banks, parts of the Cornish coast, etc., and experimented at the London Sand-blast Works, perhaps I may be permitted to refer to the results of a few observations of my own.

Mr. Vaughan Cornish, in the first part of his paper, states that "any increase in the force of the wind is accompanied by an increase in the size of grain which the wind can lift." My own observations show that this rule cannot be applied to the sands of the Poole Sandbanks, or the shell-sands of Cornwall; too much depends on the *form* and *density* of the grains.

The Poole sands are chiefly quartzose, but contain a large percentage of very small rounded grains representing the *denser minerals*. A wind may blow with sufficient force to remove, practically, all the quartz grains (large and small) from a given surface, while the *still smaller* denser grains (zircon, rutile, etc.) will be left behind, forming dark mottled patches on the sand.

I have frequently collected large quantities of sand, consisting almost entirely of denser grains, which have been separated by this natural process (*Research*, December, 1889, and vol. ii. No. 14; *Nature*, April 18, 1889).

If, after the removal of the quartz grains, we watch the action of a stronger gust of wind, we may then see these *smaller* and denser grains lifted up and carried away.

Hence grains which are heavy, and present a small surface to the wind, require a stronger blast to remove them than do larger grains of less density.

In the case of drifted shell-sand, the grains are largely tabular, lenticular, or disciform. A blast of wind may strike such grains under their flat surfaces and carry them to great distances, while the same blast would not move rounded grains, of the same bulk and material, which rested beside them. I have repeatedly observed this at many places where shell-sands occur. I found, also, that a wind which would remove six pieces of paper, each an inch square, would not necessarily remove the same pieces of paper when rolled up into balls. Hence the motion of a sand-drift, and the distance to which it travels, may depend largely upon the prevailing form or shape of the grains, rather than upon their size or the strength of the blast.

Cæteris paribus, flat grains will travel greater distances in moving air than rounded grains, and I have noticed some remarkable instances of this in Cornwall, where rounded grains of "killas" have been practically freed (on the surface) from the associated tabular calcareous grains which the wind had removed.

Many interesting experiments in this direction can be carried out at home by making use of the ordinary blowpipe blast.

C. Carus-Wilson.

Carlisle, March 16, 1897.

P.S.—In regard to Sir Frederic Goldsmid's interesting reference to the musical sand of the *Rig-i-Rawán* (*Geog. Jour.*, April), and Major Evan Smith's remarks anent the cause of the mysterious sounds emitted from these sands, some of your readers may like to know that musical notes may be artificially produced from certain sands which have been specially treated, as described by myself a few years ago (*Nature*, August 6, 1891). I am away from references at present, but believe that the *Rig-i-Rawán* was first visited by Sir Alex. Burnes in 1836. In my 'History of Musical Sand' (1888) I refer to his observations. The best *popular*, and most recent, article on the subject appeared in *Temple Bar* for September, 1895. —C. C. W.

In continuation of the discussion on this subject, General Beresford Lovett, R.E., C.B., writes from Dresden on April 8, in reference to his own personal experiences—

"Recalling the time to mind (now twenty-six years ago), I think a well-rolled Burmese gong represents the sound I heard very well as regards tone; but it was not a continuously sustained sound. As the Afghans and I, who formed line, squatting on the sand, shoved our feet in regular cadence into the sand, a note of increasing volume was given out, and this was repeated during our progression down the sand-dune over a certain zone. My own idea is that the sound emitted is entirely due to the *shape* of the hill. The rays of vibration of the air caused by the movement of the sand are focussed, as it were, and set up a major vibration, which undulates into space and addresses itself to the human ear. I don't think the substance of the hill has anything to do with the production of these sounds; but this phenomenon can only be solved by a prolonged stay at the *Ziarát*, and by making a very accurate contoured plan of the hill."

F. J. Goldsmid.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1896-97.

Afternoon Technical Meeting, Wednesday, March 17, *at* 5 *p.m.*—Sir Clements Markham, K.C.B., President, in the chair.

The Paper read was:—

"Terrestrial Magnetism, with Special Reference to the Position of the Magnetic Poles." By E. A. Reeves, F.R.A.S., Assistant Map Curator.

Ninth Ordinary Meeting, March 22, 1897.—Sir Clements Markham, K.C.B., President, in the Chair.

Elections.—*Thomas Bate*; *Henry Albert Harris Dunsford, C.E.*; *Richard Haswell Holman*; *Captain Albert Victor Jenner* (*Rifle Brigade*); *William Etheldred Jennings*; *Fredrik Lowenadler*; *Lieutenant E. C. Lyndale-Briscoe, R.N.* (*retired*); *John Wessley Martin, J.P.*; *Samuel Symington, J.P.*; *Walter John Tanner*; *Henry Times*; *Edward Tozer*; *Lindon Travers*; *Lieutenant E. T. Williams* (*11th Hussars*); *Colonel John Randel Wilmer* (*Indian Staff Corps*).

The Paper read was:—

"The North Polar Problem." By the President.

Tenth Ordinary Meeting, April 12, 1897.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

ELECTIONS.—*Baron Adolf von Andrée; Captain Cromer Ashburnham (King's Royal Rifles); George Darrell Callender; Spencer Castle; Henry Williamson Cave, M.A.; H. Arthur Doubleday; Henry Hague; Joseph Hardy.*

The Paper read was:—

"Fourth Centenary of the Voyage of John Cabota, 1497." By the President.

The Royal Awards were announced.

The PRESIDENT said: I am sure every Fellow present will be glad to know that our Vice-President has returned safely. Sir George Goldie planned with remarkable skill and ability an expedition which he has carried out with complete success, the results of which will be beneficial to a vast population. My young friend Lieut. Vandeleur will also soon return. He has added to his laurels by doing most valuable work with Sir George Goldie, and I am glad to say that the Council has this afternoon awarded to Lieut. Vandeleur Sir Roderick Murchison's grant.

You will, I think, agree that we have all endeavoured to make Dr. Nansen's stay amongst us as pleasant as possible. You will be glad to hear that Her Majesty's Government has presented to the great explorer a very handsome present, viz. a complete set of the volumes of the *Challenger* Expedition. I may perhaps add that the surviving English arctic officers have also presented Dr. Nansen with a complete set of ancient and modern works of arctic exploration.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

Austria—Galicia. *Globus* 71 (1897): 133-142. **Kaindl.**

Haus und Hof bei den Rusnaken. Mit einer Einleitung über den Namen der Rusnaken. Von Prof. Dr. Raimund Friedrich Kaindl. Czernowitz. *With Illustrations.*

The Rusnaks are of Ruthenian race.

Austrian Alps. *Sitzb. Preus. A.W. Berlin* (1896): 1255-1277. **Frech.**

Über den Gebirgsbau der Radstädter Tauern. Von Prof. Dr. F. Frech.

Austrian Alps. **Schjerning.**

Der Pinzgau. Physikalisches Bild eines Alpengaues. Von Dr. Wilhelm Schjerning. Forschungen zur deutschen Landes- und Volkskunde . . . herausgegeben von Dr. A. Kirchhoff. Zehnter Band. Heft. 2. Stuttgart: J. Engelhorn, 1897. Size 9½ × 6½, pp. [132]. *Map and Plates.*

Baltic Pilot. ———

The Baltic Pilot, Part ii., comprising directions for the Baltic Sea, including the Gulf of Finland and Gulf of Bothnia. Third Edition. London: J. D. Potter, 1896. Size 9½ × 6, pp. xxvi. and 484. *Index Chart. Price 4s. 6d. Presented by the Hydrographic Office, Admiralty.*

Belgium. *Mouvement G.* **14** (1897): 37–38. ———

Le régime fluvial de la Belgique aux temps quaternaires. *With Maps.*

Belgium—Emigration. *B.S.R.G. d'Anvers* **21** (1897): 89–126. **Donnet.**

Notes pour servir à l'histoire des émigrations anciennes des Anversois dans les pays d'Outre-Mer. Par M. Fernand Donnet.

Denmark—Sand-Dunes. **Steenstrup.**

Meddelelser fra Dansk geologisk Forening. I. K. J. V. Steenstrup: Om Klitternes Vandring. Kjøbenhavn: F. Dreyer, 1894. Size 9½ × 6, pp. 14. *Illustrations. Presented by the Author.*

Contains reproductions of maps of part of the Danish coast, showing dune-formations.

Europe—Sunshine. **König.**

Abh. K. Leopoldinisch-Carolin. Deutsch. A. Naturforscher **67** (1896): 307–395.

Dauer des Sonnenscheins in Europa. Eine meteorologische Studie. Von Helmuth König. *With Diagrams.*

France. **Martel and Delebecque.**

Sur les scialets et l'hydrologie souterraine du Vercors (Drôme). Par MM. E.-A. Martel et A. Delebecque. [Paris, 1896.] Size 11 × 9, pp. 4.

France—Adour. *B.S.G. Com. Bordeaux* **20** (1897): 65–83. **Duffart.**

Les embouchures et les lits anciens de l'Adour ayant le XVI^e^ siècle. Par Ch. Duffart. *With Map.*

This is the subject of a special note.

France—Jura and Vosges. **Delebecque.**

Jura et Vosges. Feuilles de Lons-le-Saunier, St.-Claude et Nantua. Les terrains quaternaires et les lacs du Jura français. Par M. A. Delebecque. Extrait du *Bulletin des services de la Carte géologique de la France* (Bulletin No. 55, Tome viii., 1896–1897). Size 10 × 6½, pp. 4. *Presented by the Author.*

On the glacial geology of the district named.

France—Lakes. **Delebecque.**

Sur les lacs du littoral landais et des environs de Bayonne. Par M. André Delebecque. [Paris, 1896.] Size 11 × 9, pp. 4. *Presented by the Author.*

Germany—Houses. *Globus* **71** (1897): 169–176. **Rhamm.**

Der heutige Stand der deutschen Hausforschung und das neueste Werk Meitzens. Von Karl Rhamm. I. *With Two Illustrations.*

Greece. *Z. Ges. Erdk. Berlin* **31** (1896): 385–450. **Philippson.**

Reisen und Forschungen in Nord-Griechenland. Von Dr. Alfred Philippson IV. Teil. *With Profiles.*

Greece and Italy. *J. Anthrop. I.* **26** (1897): 254–271. **Montelius.**

The Tyrrhenians in Greece and Italy. By Prof. Oscar Montelius. *With Plates.*

Pre-classical chronology in Greece and Italy. By the same.

Iceland Coast. **Wandel.**

Information relating to Currents, Ice, and Magnetism, with general remarks on the Navigation of the Coast of Iceland. By Lieut. C. F. Wandel, Royal Danish Navy, 1879. [Slightly altered in parts.] London: J. D. Potter, 1896. Size 10 × 6½, pp. 22. *Price 8d. Presented by the Hydrographic Office, Admiralty.*

These sailing directions are the first published for Iceland since 1822.

Italy. *Ric. G. Italiana* **3** (1896): 425–434, 489–508. **Frescura.**

Geografia di casa nostra. La Brenta. Del Professore B. Frescura.

Italy—Sicily. *Riv. G. Italiana* **3** (1896): 509–519. **Marinelli.**
Alcune notizie sopra il lago di Pergusa in Sicilia. Del Prof. Olinto Marinelli.
On the Lake of Pergusa, in Sicily.

Italy—Stromboli. **[Ludwig Salvator.]**
Die Liparischen Inseln. Siebentes Heft: Stromboli. Prag: H. Mercy, 1896. Size 16½ × 13, pp. x. and 52. *Map and Illustrations. Presented by H.I.H. the Archduke Ludwig Salvator.*

Mediterranean—Cyprus. *J.R. Colonial I.* **28** (1897): 195–199. **Christian.**
Cyprus and its Possibilities. By Charles Christian. [Abstract.]

Russia. *A travers le Monde, Tour du Monde (n.s.)* **3** (1897): 73–76. **Krafft.**
Aux Ruines de Bolgary. Par M. Hugues Krafft. *With Illustrations.*

Russia—Finland. *Fennia* **13** (1896): 1–64. **Berghell.**
Bidrag till kännedomen om Södra Finlands kvartära nivåförändringar. Af Hugo Berghell. *With Map and Illustrations.*
On the quaternary changes of level in South Finland, with an abstract in German.

Russia—Volga. *Rev. Scientifique* (4) **7** (1897): 397–401. **Varigny.**
Les Pêcheries de la Volga. Par M. H. de Varigny.

Spain—Pyrenees. *B.S.G. Marseille* **20** (1896): 376–395. **Saint-Yves.**
Dans les Pyrénées espagnoles. Par M. G. Saint-Yves.

United Kingdom—English Topography. **Milne.**
The Gentleman's Magazine Library: being a Classified Collection of the Chief Contents of the *Gentleman's Magazine* from 1731 to 1868. Edited by George Laurence Gomme. English Topography, Part ix. (Nottinghamshire, Oxfordshire, Rutlandshire.) Edited by F. A. Milne, M.A. London: Elliot Stock, 1897. Size 9½ × 6, pp. x. and 302. *Price 7s. 6d.*

United Kingdom—Irish Channel. *Contemporary Rev.* **71** (1897): 406–423. **Walker.**
An Irish Channel Tunnel. By J. Ferguson Walker. *With Map.*

United Kingdom—Lincolnshire. **Wheeler.**
A History of the Fens of South Lincolnshire, being a Description of the Rivers Witham and Welland and their Estuary, and an Account of the Reclamation, Drainage, and enclosure of the Fens adjacent thereto. By W. H. Wheeler. Second edition. Boston: J. M. Newcomb. London: Simpkin, Marshall & Co., [1896]. Size 10 × 6½, pp. 489, 43, 8, 14, 15, 17, 2, 4, 31, and 6. *Maps and Diagrams. Presented by the Publisher.*
This will be specially noticed.

United Kingdom—Tide Tables. **Harris and Goalen.**
Tide Tables for the British and Irish Ports, for the year 1897; also the times and heights of High Water at full and change for the principal places on the Globe. By Captains H. R. Harris and W. N. Goalen. London: J. D. Potter [1897]. Size 10 × 6½, pp. xl. and 264. *Price* 1s. 6d. *Presented by the Hydrographic Office, Admiralty.*

ASIA.

Asiatic Turkey. **Paterson.**
From Bombay through Babylonia. By Rev. James Graham Paterson. Glasgow: D. Bryce & Son, 1896. Size 7½ × 5, pp. 204. *Map and Illustrations. Presented by W. W. Hind Smith, Esq.*
A narrative of a missionary journey.

China. *A travers le Monde, Tour du Monde (n.s.)* **3** (1897): 81–84. **Bonin.**
A travers le Yun-Nan, le Thibet et la Mongolie. Exploration de M. Ch. E. Bonin. *With Illustrations.*

China Sea Directory.
The China Sea Directory. Vol. i. Containing Directions for the Approaches to the China Sea, by Malacca, Singapore, Sunda, Banka, Gaspar, Carimata, Rhio, Berhala, and Durian Straits. Fourth Edition. London: J. D. Potter, 1896. Size 9½ × 6, pp. xxiv. and 614. *Index Chart. Price* 4s. *Presented by the Hydrographic Office, Admiralty.*

India. *J.S. Arts* **45** (1897): 345–374. **Elliott.**
On Measures taken by Government for the Prevention of Famine in India. By Sir Charles A. Elliott, K.C.S.I.

India. **Frazer.**

British India. By R. W. Frazer, LL.D. (The Story of the Nations Series.) London: T. Fisher Unwin, 1896. Size 8 × 5½, pp. xviii. and 400. *Maps, Portraits, and Illustrations. Price 5s. Presented by the Publisher.*

A history of India from the invasion of Alexander the Great to the relief of Chitral, but the earlier centuries occupy only one short chapter, the greatest detail being given to the history of the East India Company, and the progress of India since its power was superseded. There is a map of India and several illustrations.

India—Andaman Islands. **Buchanan.**

Report and Appendices on Forests situated around Stewart Sound, North Andamans. By E. M. Buchanan. Port Blair, 1895. Size 13½ × 8½, pp. (Report) 20, map; (Appendices) xxvi. *Presented by the Chief Commissioner of the Andamans and Nicobars.*

India—Andaman and Nicobar Islands. **Temple.**

Reports and Remarks on Tours of the Chief Commissioner, Andaman and Nicobar Islands, in September and October, 1894; January and February, and March and April, 1895. Size 13 × 8½. *Maps. Presented by the Chief Commissioner of the Andamans and Nicobars.*

A special note is given in the Monthly Record on these reports.

India—Assam. ———

Report on the Administration of the Province of Assam, for the year 1895-96. Shillong, 1896. Size 13 × 8½, pp. xvi., 208, and cxcviii. *Map. Presented by the Secretary of State for India.*

India—Burma. ———

Tables for the Transliteration of Burmese into English, with Lists showing the names in English and Burmese of the Divisions, Districts, Sub-divisions, Townships, and Circles of Burma; also of the Post Offices, Railway Stations, Police Offices, and other places of interest. Rangoon, 1896. Size 10 × 6½, pp. xviii. and 202. *Presented by the Quartermaster-General in India.*

India—Famines. *J.E. India Assoc.* **29** (1897): 9-30. **Cunningham.**

Indian Famines. By Sir H. S. Cunningham, K.C.I.E. *With Maps.*

The maps show the distribution and area of the famine districts in 1833, 1837, 1854, 1860-61, 1865-66, 1868-69, 1873-74, and 1876-78.

India—N.-W. Provinces and Oudh. ———

Report on the Administration of the N.-W. Provinces and Oudh for the year ending March 31, 1896. Allahabad, 1897. Size 13½ × 8½, pp. iv., xxxvi., 198, iv., and 186. *Presented by the Secretary of State for India.*

India—Punjab. ———

Report on the Administration of the Punjab and its Dependencies for 1895-96. Lahore, 1897. Size 13½ × 8½, pp. xii., 238, and clxxx. *Map. Presented by the Secretary of State for India.*

This map shows the Punjab railways corrected up to 1896.

Korea. **Hamy.**

Documents sur l'anthropologie de la Corée. Par M. E.-T. Hamy. Extrait du *Bulletin du Muséum d'histoire naturelle*, 1896, No. 4. Size 10 × 6½, pp. 4.

Malay Archipelago—Java. **Verbeek and Fennema.**

Description géologique de Java et Madoura. Par Dr. R. D. M. Verbeek et F. Fennema. Publiée par ordre de son Excellence le Gouverneur général des Indes Néerlandaises. 2 vols. Amsterdam: J. G. Stemler Cz., 1896. Size 10 × 7, pp. xlvi and 1184, plates. Atlas accompanying, size 22½ × 27. *Presented by the Minister of the Dutch Colonies.*

This fine monograph will be specially noticed.

Malay Archipelago—Lombok. **Cool.**

With the Dutch in the East. An outline of the Military Operations in Lombock, 1894, giving also a Popular Account of the Native Characteristics, Architecture, Methods of Irrigation, Agricultural Pursuits, Folklore, Religious Customs, and a History of the Introduction of Islamism and Hinduism into the Island. By Captain W. Cool (Dutch Engineers). Translated from the Dutch by E. J. Taylor. With a Copious Index, a small Glossary of foreign Words and Lists of Authorities quoted. London: Luzac & Co., 1897. Size 10½ × 7, pp. viii., 366, and viii. *Map and Illustrations. Price 21s. Presented by the Publishers.*

A special note will be given on this book.

Malay Archipelago—Moluccas. **Hendriks.**

Het Burusch van Màsarète. Door H. Hendriks, te Màsarète (eiland Buru). Uitgegeven door het Koninklijk Instituut voor de Taal-, Land- en Volkenkunde van Nederlandsch-Indië. 'S-Gravenhage, Martinus Nijhoff, 1897. Size 10 × 6½, pp. 176.

Persia. *J. Tyneside G.S.* **3** (1896): 311–320. **Goldsmid.**

Persia and Her Neighbours (Part ii.). By Major-General Sir Frederic J. Goldsmid, K.C.S.I., C.B.

Philippine Islands. *Z. Ges. Erdk. Berlin* **31** (1896): 369–372. **Blumentritt.**

Neue Nachrichten über die Subanon (Insel Mindanao). Nach P. Francisco Sanchez. Von Professor F. Blumentritt.

Philippine Islands. *B.S. d'Études colon* **3** (1896): 257–389. **Leval.**

Les Iles Philippines. Par G. De Leval, avocat.

Russian Central Asia. *Globus* **71** (1897): 152–155. **Vambéry.**

Bilder aus Samarkand. Von H. Vambéry. *With Illustrations.*

Syria—Damascus. *J.R.I. British Architects* (3) **4** (1896): 25–40, 57–65. **Spiers.**

The Great Mosque of the Omeiyades, Damascus. By R. Phenè Spiers. *With Illustrations.*

AFRICA.

Africa—Journey across. **Miot.**

Mouvement Antiesclavagiste Belge **8** (1896): 242–247, 329–334, 357–362, 387–390.

La traversée du continent noir. Notes de voyage de M. F. Miot.

This crossing of Africa took place from the mouth of the Zambesi to the mouth of the Congo.

Africa—Political Division. **Hertslet.**

The Map of Africa by Treaty. (Second and Revised Edition.) Vol. i. Abyssinia to Great Britain (Colonies). Nos. 1 to 102. With amended Maps.—Vol. ii. Great Britain and France to Zanzibar. Nos. 103 to 208. With amended Maps.—Vol. iii. Appendix, Alphabetical Index, and Chronological List. With Two Maps. By Sir Edward Hertslet, K.C.B. London: Eyre & Spottiswoode, 1896. Size 10½ × 6½, pp. xxviii. and 1078. *Price* 31*s.* 6*d.*

Some inaccuracies having been detected in the maps of the first edition of this work, it was withdrawn from circulation, and the opportunity has been taken, in issuing it with revised and accurate maps, to bring the whole work up to a later date, the chronological index coming down to November, 1895, the preface being dated February, 1896.

Algeria. *J. Asiatique* (9) **8** (1896): 361–394. **Basset.**

Notes sur le Chaouia de la province de Constantine. Par M. René Basset.

British Central Africa—Lake Moëro. *Mouvement G.* **14** (1897): 27–29. ———

Le lac Moëro et le delta du Luapula.

British East Africa. **Macdonald.**

Soldiering and Surveying in British East Africa, 1891–1894. By Major J. R. L. Macdonald, R.E. London: E. Arnold, 1897. Size 9½ × 6, pp. xvi. and 334. *Maps and Illustrations. Price* 16*s. Presented by the Author.*

This will be referred to along with other books on Africa.

British East Africa—Lake Albert Edward. *Mouvement G.* **14** (1897), 13–18. **Wauters.**

Comment le bassin de l'ancienne mer intérieure "Albert Édouard" a été rattaché au bassin du Nil par la Semliki. Deuxième Article. Par A.-J. Wauters. *With Map.*

Cape Colony—Kimberley. *Nature* **55** (1897): 519–523. **Crookes.**

The Diamond Mines of Kimberley. By Dr. William Crookes, F.R.S.

Cape Colony—Kimberley. *Symons's Monthly Meteorolog. Mag.* **32** (1897): 17–20. **Sutton.**

Sunshine at Kimberley, S. Africa. By J. R. Sutton, B.A.

Congo State. *B.S.R.G. d'Anvers* **21** (1897): 23–42. **Danco.**

Le Congo, conférence par M. P. Danco.

Congo State. *Mouvement G.* **14** (1897): 25–27. **Stache.**

De Bena-Bendi à Gallikoko (Kassaï-Sankuru). Par E. Stache. *With Illustrations.*

Egypt—Alexandria. **Franceschi.**

Le climat d'Alexandrie comparé à celui du Caire. Par le Professeur Eugène Franceschi. Supplément au Bulletin No. 10, Série IV. de la Société Khédiviale de Géographie. Le Caire, 1896. Size 9½ × 6½, pp. [40].

Egypt—Alexandria. *Nineteenth Century* (1897): 437–445. **Mahaffy.**

About Alexandria. By Professor J. P. Mahaffy.

German South-West Africa. *Verh. Ges. Erdk. Berlin* **24** (1897): 103–113. **Esser.**

Herr Dr. Max Esser: Meine Reise nach dem Kunene im nördlichen Grenzgebiet von Deutsch-Südwest-Afrika. *With Map.*

German South-West Africa. *Verh. Ges. Erdk. Berlin* **24** (1897): 113–141. **Hartmann.**

Herr Premierlieutenant Dr. Hartmann: Das Kaoko-Gebiet in Deutsch-Südwest-Afrika auf Grund eigener Reisen und Beobachtungen. *With Map and Illustrations.*

Marocco—Cape Juby. *Scottish G. Mag.* **13** (1897): 113–120. **Zaytoun.**

Cape Juby. By Fred. S. Zaytoun, M.B., C.M.

Portuguese East Africa. *B.S.G. Lisboa* **15** (1896): 375–378. ———

O Inhampallala. *With Map.*

Sahara. *B.S.G. Marseille* **20** (1896): 360–375. **Foureau.**

Mes missions sahariennes de 1876 à 1896, conférence de M. F. Foureau. *With Map.*

Sahara. *Deutsche Rundschau G.* **19** (1897): 254–266. **Thilenius.**

Die Expedition des Marquis de Morès. Von Dr. G. Thilenius.

Somaliland. **Smith.**

Through Unknown African Countries. The First Expedition from Somaliland to Lake Lamu. By A. Donaldson Smith, M.D. London: E. Arnold, 1897. Size 10½ × 7, pp. xvi. and 472. *Maps, Portrait, and Illustrations. Price* 21*s. Presented by Dr. J. Scott Keltie.*

This will be noticed along with other books on Africa.

South Africa. *Rev. Scientifique* (4) **7** (1897): 193–203. **Launay.**

La prise de possession de l'Afrique australe. Par M. L. de Launay.

South Africa. *Nineteenth Century* (1897): 366–386. **Villiers.**

England's Advance North of Orange River. By Melius de Villiers.

South Africa—Manika Land. *B.G. Club Philadelphia* **2** (1896): 33–40. **Farnum.**

A Trip to Manika Land. By J. Edward Farnum. *With Map.*

Tunis. **Hamy.**

La Nécropole Berbère d'Henchir el-'Assel près de Dar-bel-Ouar (Tunisie). Par M. le Docteur E.-T. Hamy. (Extrait des *Comptes rendus de l'Académie des inscriptions et belles-lettres.*) [Paris, 1896.] Size 9 × 6, pp. 8.

Upper Nile. **Martonne.**

La vie des Peuples du Haut-Nil, explication de trois cartes Anthropogéographiques. Par E. de Martonne. (Extrait des *Annales de Géographie*) (Octobre 1896—Janvier 1897.) Paris: A. Colin & Cie. Size 10 × 6½, pp. [28]. *Maps. Presented by the Author.*

This will be specially noticed.

West Africa—Niger. *C. Rd., S.G. Paris* (1897): 24–51. **Hourst.**

Réception de la Mission Hourst. Le Niger (de Tombouctou à l'embouchure du fleuve). *With Map.*

NORTH AMERICA.

American Indians. *J. Anthrop. I.* **26** (1897): 221–247. **Hale.**

Four Huron Wampum Records: a Study of Aboriginal American History and Mnemonic Symbols. By Horatio Hale, M.A. (Harvard), etc. *With Plates.*

America—the name. **Franciot-Legall.**

L'Amérique a-t-elle droit sous ce nom à un nom indigène? Documents cartographiques. Documents linguistiques. Par X. Franciot-Legall. Paris: Ch. Chadenat, 1896. Size 9 × 6, pp. 88. *Facsimile Maps. Presented by the Author.*

Canada. **Bourinot.**

Canada. By J. G. Bourinot, C.M.G., etc. (The Story of the Nations.) London: T. Fisher Unwin, 1897. Size 8 × 5¼, pp. xx. and 464. *Maps and Illustrations. Price 5s. Presented by the Publisher.*

A short and attractive history of Canada, published at a convenient time in view of the approaching meeting of the British Association at Toronto.

Canada. *J. Tyneside G.S.* **3** (1896): 285–299. **Smith.**

The Resources of Canada. By Sir Donald A. Smith, G.C.M.G. (High Commissioner for Canada). *With Portrait.*

Canada—Geological Survey. ———

Summary Report of the Geological Survey Department for the year 1896. Ottawa, 1897. Size 10 × 6½, pp. 144.

Great Lakes. ———

No. 108. [U.S.] Hydrographic Office. Sailing directions for the Great Lakes and connecting waters. Washington, 1896. Size 9½ × 6, pp. 242. *Maps. Presented by the U.S. Hydrographic Office.*

With maps of the currents in the great lakes.

Labrador and Baffin Land. **Tarr.**

Evidence of Glaciation in Labrador and Baffin Land. By Ralph S. Tarr. [From the *American Geologist*, vol. xix., March, 1897.] Size 10 × 6½, pp. [8]. *Plate.*

Some fine photographs of *roches moutonnees* are here reproduced.

Mexico—Maya Inscriptions. **Goodman.**

Biologia Centrali-Americana. . . . Edited by F. Ducane Godman and Osbert Salvin. Archæology. [Part viii., February, 1897.] Appendix: The Archaic Maya Inscriptions. By J. T. Goodman. London: R. H. Porter. Size 13 × 10½, pp. x. and 150.

This part contains the preliminary labours of an American specialist, forming a section of a joint work with Dr. Gustav Eisen, at which they have long laboured. It gives many details of the inscriptions relating to dates, and discusses the Maya calendar in great detail.

North America—West Coast. **Maclear.**

Sailing Directions for the West Coasts of Central America and the United States. Compiled . . . by Rear-Admiral J. P. Maclear. London: J. D. Potter, 1896. Size 9½ × 6, pp. xx. and 482. *Index Charts. Price 3s. Presented by the Hydrographic Office, Admiralty.*

Treats of the west coast of Central America, Mexico, and the United States as far as Cape Flattery.

United States. *P. Boston S. Nat. Hist.* **27** (1896): 185–193. **Batchelder.**

Some Facts in regard to the Distribution of Certain Mammals in New England and Northern New York. By Charles F. Batchelder.

United States. *National G. Mag.* **8** (1897): 49–57. **Best.**

The Utilization of the vacant Public Lands. By Emory F. Best.

United States. **Maitland.**

The Geological Structure of Extra-Australian Artesian Basins. By A. Gibb Maitland. [Read before the Royal Society of Queensland, April 17, 1896.] Size 8½ × 5½, pp. 26. *Sections. Presented by the Author.*

This paper deals with the Artesian basins in North America.

United States—Appalachians. *J. School Geography* **1** (1897): 33–41. **Semple.**

The Influence of the Appalachian Barrier upon Colonial History. By Ellen C. Semple.

United States—Bureau of Navigation. ———

Navy Department. Annual Report of the Hydrographer to the Bureau of Navigation for the Fiscal Year ending June 30, 1896. Washington: 1896. Size 9½ × 6, pp. 20.

United States—Coast and Geodetic Survey. *Science (n.s.)* **5** (1897): 384–388. ———

The Coast and Geodetic Survey. By J.

A powerful criticism of the present administration of the U.S. Coast and Geodetic Survey.

United States—Massachusetts. *P. Boston S. Nat. Hist.* **27** (1896): 159–161. **Bangs.**

An important addition to the Fauna of Massachusetts. By Outram Bangs.

United States—Montana. *B. American G.S.* **28** (1896): 387–391. **Brower.**

The Utmost Waters of the Missouri River. By J. V. Brower. *With Chart and Illustrations.*

United States—New England. **Henry.**

U.S. Department of Agriculture, Weather Bureau. Bulletin No. 19. Report on the Relative Humidity of Southern New England and other localities. Prepared under the direction of Willis L. Moore. By Alfred J. Henry. Washington: Weather Bureau, 1896. Size 9½ × 6, pp. 24. *Diagrams.*

United States—Oregon. *American J. Sci.* (4) **3** (1897): 165–172. **Diller.**

Crater Lake, Oregon. By J. S. Diller. *With Illustration.*

A paper by the same author with the same title and with a map appears in the *National Geographic Magazine*, vol. 8 (1897), pp. 33–48.

United States—Oregon. *Deutsche Rundschau G.* **19** (1897): 193–208. **Röll.**

Der Mount Hood im nordamerikanischen Cascaden-Gebirge. Von Dr. Julius Röll in Darmstadt. *With Illustrations.*

United States—Texas. *P. Boston S. Nat. Hist.* **27** (1896): 149–158. **Marcou.**

The Jura of Texas. By Jules Marcou.

United States—Virginia. **Arnold.**

Johns Hopkins University Studies in Historical and Political Science. Fifteenth Series. I.—II. History of the Tobacco Industry in Virginia from 1860 to 1894. By B. W. Arnold, Jr., PH.D. Baltimore, 1897. Size 10 × 6½, pp. 86.

United States—Washington Observations. **Marsh.**

Washington Observations, 1894.—Appendix I. Magnetic Observations at the United States Naval Observatory, 1894. By C. C. Marsh, Lieut., U.S. Navy. Washington: 1895. Size 11½ × 9½, pp. 114. *Plates. Presented by the U.S. Naval Observatory.*

Includes a description of the U.S. Naval Observatory at Washington, which was removed to its present position in 1893.

CENTRAL AND SOUTH AMERICA.

Argentine Republic. *Globus* **71** (1897): 165–169. **Ambrosetti.**

Die Entdeckung megalithischer Denkmale im Thale Tafí. (Prov. Tucumán der Argentinischen Republik.) Von Juan B. Ambrosetti. Buenos-Aires. Zeichnungen von Federico Voltmer. *With Illustrations.*

British Guiana—Cuyuni River. *Timehri* (*n.s.*) **10** (1896): 310–334. **Hilhouse.**

Up the Cuyuni in 1837. By William Hilhouse.

British Guiana—Potaro River. *Timehri* (*n.s.*) **10** (1896): 335–356. **Lloyd.**

On the Potaro. By C. A. Lloyd.

Chili. *Verh. Ges. Erdk. Berlin* **24** (1897): 70–71. **Polakowsky.**

Neue Forschungsreisen im südlichen Chile. Von Dr. H. Polakowsky.

Chili—Andes. *Sitzb. Preus. A.W. Berlin* (1896): 1161–1171. **Moericke.**

Geologisch-petrographische Studien in den chilenischen Anden. Von Dr. W. Moericke.

Nicaragua Canal. *Z. Ges. Erdk. Berlin* **31** (1896): 373–385. **Polakowsky.**

Der Nicaragua-Kanal. Von Dr. H. Polakowsky.

Peru—Eastern Rivers. *B.S.G. Lima* **5** (1896): 427–434. **Carvajal.**

Navegabilidad de los rios orientales del Perú. Por el Capitán de Navio M. Melitón Carvajal. *With Map.*

The rivers referred to are the Maranon, Ucayali, and their tributaries.

Peru—Lake Titicaca. *P. Philosoph. S. Glasgow* **27** (1896): 147–150. **Wilson.**

Visit to Lake Titicaca, Peru. By Mr. John Wilson.

Description of the transport of a 550-ton steamer from the Clyde to Lake Titicaca. The steamer was shipped in sections, landed at Mollendo in lighters, and taken by rail to the lake.

Peru—Lima. *B.S.G. Lima* **6** (1896): 43–63. **Carvajal.**

La latitud de Lima. Por el Capitán de Navio M. Meliton Carvajal.

After discussing all the recorded determinations of the latitude of Lima, the author arrives at 12° 2′ 58·7″ S. as the position of the south tower of the cathedral at Lima.

Salvador. *Petermanns M.* **43** (1897): 1–7. **Sapper.**

Vulkane in Salvador und Südost-Guatemala. Von Dr. K. Sapper. *With Map.*

South America. *B.S.G. Lisboa* **15** (1896): 263–328. **Mendes.**

America austral. Cartas escriptas da America nos annos de 1882 a 1883. Por A. Lopes Mendes. Terceira parte.

Venezuela. *J. Tyneside G.S.* **3** (1896): 300–310. **Curtis.**

Venezuela: Her Government, People, and Boundary. By William E. Curtis. *With Illustrations.*

Venezuela—Boundary. ———

Venezuelan Boundary—General Arbitration. Correspondence between the United States and Great Britain. [1896] Size 13 × 8, pp. 30. *Presented by the United States Government.*

AUSTRALASIA AND OCEANIC ISLANDS.

Australasia. *J.S. Arts* **45** (1897): 390–398. **Bonwick.**

The Progress of the British Colonies of Australasia during the Sixty Years of Her Majesty's Reign. By James Bonwick.

Central Australia—Horn Expedition. **Winnecke.**

South Australia. Journal, etc., of the Horn Scientific Exploring Expedition to Central Australia. (With plates and plans.) 1894. By C. Winnecke, Leader of the Expedition. Adelaide, 1896. Size 13½ × 8½, pp. 32. 2 *Copies—one presented by Mr. C. Winnecke, the other by the Secretary of State for the Colonies.*

German New Guinea. *Verh. Ges. Erdk. Berlin* **24** (1897): 51–69. **Lauterbach.**

Herr Dr. Carl Lauterbach: Bericht über die Kaiser Wilhelm-Land-Expedition im Jahr 1896. *With Map.*

New Hebrides—Funafuti. *P.R.S.* **60** (1897): 502–512. **Sollas.**

Report to the Committee of the Royal Society appointed to investigate the Structure of a Coral Reef by Boring. By W. J. Sollas, D.Sc., etc. *With Illustrations.*

New South Wales. ———

The Snowy Mountains and Mount Kosciusko. The Cooma Railway and Monaro District, New South Wales. [Sydney, 1896.] Size 9 × 6, pp. 16. *Map and Illustrations.*

Queensland. **Jack.**

Queensland. Department of Mines. Geological Survey. Bulletin No. 4. Notes on the Present Condition of the Hodgkinson Gold Field. By Robert L. Jack. Brisbane, 1896. Size 9 × 6, pp. 16.

Tahiti. *Rev. Française* **22** (1897): 129–142. **Mager.**

Grandeur et décadence des établissements de Taïti. Lettre de M. H. Mager.

Victoria—Statistics. ———

Statistical Register of the Colony of Victoria, etc., 1894. Melbourne. Size 13 × 8½.

West Australia. ———

Western Australian Statistics of Gold Output. Reprinted by permission of the *Statist* and *Australian Mail*. London: Printed by Sir Joseph Causton & Sons, 1896. Size 5 × 8, pp. 56.

West Australia. *Deutsche Rundschau G.* **18** (1896): 356–366. **Mayr.**

West-Australien. Von Emil Mayr. *With Map.*

West Australia—Israelite Bay. **Brooke.**

Natural Features of Israelite Bay. By J. P. Brooke.—Report of the Sixth Meeting of the Australasian Association for the Advancement of Science, held at Brisbane, Queensland, January, 1895. Sydney. Size 9 × 6, pp. 561–569.

POLAR REGIONS.

Antarctic. *Rev. Scientifique* (4) 7 (1897): 329–334. **Heilprin.**

Les régions antarctiques. Par M. A. Heilprin.

Translated from the *Popular Science Monthly*.

Arctic. **Barton.**

Evidence of the Former Extension of Glacial Action on the West Coast of Greenland and in Labrador and Baffin Land. By George H. Barton. [From the *American Geologist*, vol. xviii., December, 1896.] Size 9½ × 6½, pp. [6]. *Presented by the Author.*

Arctic—Erosion. **Tarr.**

Rapidity of Weathering and Stream Erosion in the Arctic Latitudes. By R. S. Tarr. [From the *American Geologist*, vol. xix. February, 1897.] Size 10 × 6½, pp. [6]. *Plate. Presented by the Author.*

Professor Tarr brings forward evidence of the remarkable power of surface water in eroding the land in Arctic regions, drawing his illustrations mainly from Baffin Land and Greenland.

Arctic—Ice limits. *C. Rd. S.G. Paris* (1897): 9–16. **Rabot.**

Les limites des glaces flottantes autour du Spitzberg et de la Nouvelle-Zemble pendant l'été 1894, d'après les renseignements fournis par des capitaines norvégiens. Rapport présenté à la Commission centrale de la Société de Géographie. Par M. Charles Rabot. *With Sketch-Maps.*

Arctic Sea Ice. *American J. Sci.* (4) 3 (1897): 223–229. **Tarr.**

The Arctic Sea Ice as a Geological Agent. By Ralph S. Tarr.

Polar Exploration. *Petermanns M.* 43 (1897): 15–18. **Supan.**

Unbekannte Polargebiete. Kurze Betrachtungen zur Karte der Grenzen der unbekannten Polargebiete. Von Prof. Dr. A. Supan. *With Map.*

The map gives a quantity of interesting relations between the exploration of the Arctic and Antarctic regions, and the amount of work done in successive centuries.

Spitsbergen and Novaya Zemlya. **Barry.**

Zwei Fahrten in das nördliche Eismeer nach Spitzbergen und Novaja Zemlja unternommen von Sr. Kön. Hoheit Prinz Heinrich von Bourbon, Graf von Bardi an Bord der österreichischen Jachten "Fleur de Lys I. und II." des k. und k. Jacht-Geschwaders in den Jahren 1891 und 1892, geschildert von Richard Ritter von Barry, k. und k. Linienschiffslieutenant. Im Auftrage des k. und k. Reichs-Kriegs-Ministeriums (Marine-Section) herausgegeben von der Redaction der Mittheilungen aus dem Gebiete des Seewesens. Pola: Carl Gerold's Sohn, 1894. Size 10 × 6½, pp. viii., 170, and 66. *Portraits, Maps, and Illustrations. Price* 9*s.*

A record of two yacht cruises along the west coast of Spitsbergen to beyond 80° N., accompanied by maps and numerous plans of bays, and followed by a full meteorological log.

MATHEMATICAL GEOGRAPHY.

Artificial Horizon. *Ann. Hydrographiques* (2) (1896): 253–300. **Schwerer.**

Instructions théoriques et pratiques sur l'horizon gyroscopique dans le vide de M. le contre-amiral Fleuriais. Par M. A. Schwerer. *With Plates.*

Artificial horizons carried by a gyroscope *in vacuo* have been experimented with on some of the vessels of the French navy. This paper fully describes the instrument, and gives a complete discussion of the manner of using it.

Cartography. *Ann. Hydrographiques* (2) (1896): 26–39. ——

Rapport sur les règles à adopter pour les légendes des feux sur les cartes.

On the new symbols authorized in 1895 by the French Marine for representing the different classes of lights on charts.

Cartography. *G.Z.* 3 (1897): 65–79. **Hammer.**

Die Kartennetzentwürfe. Von Prof. E. Hammer.

On the construction of various map-projections.

Clock-dials. *Rev. Scientifique* (4) 7 (1897): 240–243. **Houzeau.**

Pourquoi les cadrans de nos horloges sont-ils divisés en douze. Par M. Houzeau.

Map of the World. **Barbier.**

Projet de Carte de la Terre à l'échelle du 1/1,000,000. Rapport presenté au Congrès de Lorient. Par J.-V. Barbier au nom de la Commission technique de la Société de Géographie de l'Est. Nancy: Imp. Berger-Levrault et Cie., 1896. Size 9 × 6, pp. 20. *Map. Presented by the Author.*

Positions. *Rev. Scientifique* (4) 7 (1897): 394–397. **Durand-Gréville.**

Détermination du point sans sextant. Par M. E. Durand-Gréville.

A note is given on this paper.

Surveying. **Clancey.**

Aid to Land-Surveying (Small Edition), in English and Burmese; accompanied by 237 illustrations on the subject, and containing numerous useful tables. By J. C. Clancey. Third Edition. Revised and Enlarged. Rangoon, 1895. Size 13 × 8½, pp. iv., 80, [140], 28, 8, 6, and 10. *Presented by the Author.*

Surveying—Tables. **Clancey.**

Calculating Tables in English and Burmese for use in Burma. By J. C. Clancey. Third Edition. Revised and Enlarged. Rangoon, 1896. Size 13 × 8½, pp. 232 and 10. *Charts, etc. Presented by the Author.*

Time and Angles. *Rev. Scientifique* (4) 7 (1897): 15–19. **Rey-Pailhade.**

Projet d'extension du système décimal aux mesures du temps et des angles. Par M. J. de Rey-Pailhade.

Time Standards. *J. Manchester G.S.* 11 (1895): 248–254. **Greenwood.**

"Unification of Time" as it Relates to the Practice of the Science of Navigation. By Mr. W. Nelson Greenwood.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Atmospheric Refraction. **Delebecque.**

Sur les réfractions extraordinaires observées au bord des lacs et connues sous le nom de *Fata Morgana*. Par M. André Delebecque. [Paris, 1896.] Size 11 × 9, pp. 4. *Presented by the Author.*

Climate. **Zenker.**

Abh. K. Leopoldinisch-Carolin. Deutsch. A. Naturforscher 67 (1896): 1–252.

Der thermische Aufbau der Klimate aus den Wärmewirkungen der Sonnenstrahlung und des Erdinneren. Von Dr. W. Zenker. *With Maps.*

An investigation of the joint influence on climate of solar and internal Earth heat.

Coral Atolls. *Nature* 55 (1897): 390–393. **Wharton.**

Foundations of Coral Atolls. By Rear-Admiral W. J. L. Wharton, C.B., F.R.S. *With Plan.*

Cosmogony. *C. Rd.* 123 (1896): 1094–1097. **Quinton.**

Le refroidissement du globe, cause primordiale d'évolution. Note de M. R. Quinton.

Density of Earth. **Richarz, and Krigar-Menzel.**

Sitz. K.P.A. Wiss, Berlin (1896): 1305–1318.

Gravitations-constante und mittlere Dichtigkeit der Erde, bestimmt durch Wägungen. Von Prof. Dr. Franz Richarz und Dr. Otto Krigar-Menzel.

Oceanography. **Makaroff.**

Le "Vitiaz" et l'Océan Pacifique. Observations hydrologiques faites par les officiers de la corvette "Vitiaz" pendant un Voyage autour du Monde, executé de 1886 à 1889, et recueil des observations sur la température et le poids spécifique de l'eau de l'Océan Pacifique Nord. Par le Contre-Amiral S. Makaroff. 2 vols. (in 1). St.-Pétersbourg, 1894. Size 12 × 8½, pp. (vol. i.) xliv. and 338; (vol. ii.) 512. *Maps and Plates. Presented by the Russian Admiralty.*

This important work will be referred to in the Monthly Record.

Oceanography. **Thoulet.**

Océanographie (Dynamique). Première partie. Par M. J. Thoulet. Paris: L. Baudoin, 1896. Size 10 × 6½, pp. 132. *Maps and Diagrams. Price* 4*s.*

A special notice of this work will be given when it is complete.

Oceanography—Apparatus. **Richard.**

Sur un appareil destiné à démontrer que la quantité des gaz dissous dans les grandes profondeurs de la mer est indépendante de la pression. Par M. Jules Richard. [Paris, 1896.] Size 11 × 9, pp. 4. *Illustration.*

Oceanography—Faeroe Channel. **Moore.**

Reports of Proceedings in connection with investigations into the physical conditions of the water of the Faeroe Channel. By Captain W. U. Moore, R.N., H.M.S. *Research*, 1896. Hydrographic Department, Admiralty, London. Size 13½ × 9, pp. 32. *Chart and Diagrams.*

A note on this Report will appear in the Monthly Record.

Pacific—Balfour Shoal. *Scottish G. Mag.* **13** (1897): 120–134. **Murray.**

Balfour Shoal: a Submarine Elevation in the Coral Sea. By John Murray, F.R.S., of the *Challenger* Expedition. *With Chart and Diagram.*

Sub-lacustrine ravines. **Delebecque.**

Les ravins sous-lacustres des fleuves glaciaires. Par A. Delebecque. Extrait des *Archives des Sciences physiques et naturelles.* Quatrième période, t. i. Mai 1896. Genève. Size 9 × 6, pp. 4.

Some evidence to confirm M. Forel's theory of the formation of ravines in the bed of lakes at the entrance of glacial rivers.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropology **Hamy.**

Dr. E.-T. Hamy. Les races Malaïques et Américaines. Leçon d'ouverture du Cours d'Anthropologie du Muséum d'Histoire Naturelle (19 Mars 1896). Extrait de "l'Anthropologie." T. vii. No. 2. Paris: Masson et Cie. [1896]. Size 10 × 6½, pp. 18. *Presented by the Author.*

Anthropology—Gypsies. **Cora.**

Prof. Guido Cora. Die Zigeuner. Turin [1895]. Size 10 × 7, pp. 100. *Presented by the Author.*

Prof. Guido Cora has reprinted from *Ausland* a series of papers on the Gypsies of Europe. Out of a total of 779,000 European Gypsies it appears that Rumania contains no less than 250,000, Hungary comes next with 150,000, the United Kingdom is credited with 12,000, and Norway and Sweden with 1500.

Exploration. *Fortnightly Rev.* (*n.s.*) **61** (1897): 556–567. **Salmon.**

1497–1897: East and West. By Edward Salmon.

Touches on the voyage of Cabot and other pioneer voyages of the fifteenth and sixteenth centuries.

Historical—Discovery of America. **Batalha-Reis.**

The supposed Discovery of South America before 1448, and the Critical Methods of the Historians of Geographical Discovery. By J. Batalha-Reis. From the *Geographical Journal* for February, 1897. Size 10 × 6½, pp. 26.

BIOGRAPHY.

Daubrée. *Rev. Scientifique* (4) **7** (1897): 321–329. **Meunier.**

L'œuvre scientifique de M. A. Daubrée. Par M. Stanislas Meunier.

Engel. *Deutsche Rundschau G.* **19** (1897): 280–282. ———

Dr. Ernst Engel. *With Portrait.*

Dr. Engel, who died in December, 1896, was for many years identified with the Statistical Department of the Kingdom of Saxony.

Goode. *Science* (*n.s.*) **5** (1897): 365–378. **Adler, Langley, and Osborn.**

Goode Memorial Meeting. By Cyrus Adler.
George Brown Goode. By S. P. Langley.
Goode as a Naturalist. By Henry F. Osborn.

Rhins. *Deutsche Rundschau G.* **19** (1897): 233–235. **Wolkenhauer.**

Jules Dutreuil de Rhins. Von W. Wolkenhauer. *With Portrait and Map.*

Rohlfs. *Deutsche G. Blätter* **19** (1896): 165–182. **Wolkenhauer.**

Gerhard Rohlfs. Von Dr. W. Wolkenhauer.

Simony. *G.Z.* **2** (1896): 657–662. **Peucker.**

Friedrich Simony. (Geb. 30. Nov. 1813—gest. 20. Juli 1896.) Von Dr. K. Peucker.

Thomson. **Thomson.**

Joseph Thomson, African Explorer. A Biography by his brother (Rev. J. B. Thomson, Greenock), with contributions by friends. London: Low & Co., 1896. Size 8 × 8½, pp. x. and 358. *Portrait, Maps, and Illustrations.* *Price 7s. 6d. Presented by the Publishers.*

This will be specially noticed.

Waiting. *Science* (*n.s.*) **5** (1897): 300–302. ———

Henry L. Whiting.

Mr. Whiting was long engaged on the United States Coast Survey, and on the Massachusetts Survey.

Zehden. *Deutsche Rundschau G.* **19** (1897): 278–280. ———

Dr. Karl Zehden. *With Portrait.*

GENERAL.

Admiralty—Catalogue of Charts, etc. ———

Catalogue of Admiralty Charts, Plans, and Sailing Directions, 1897. London: J. D. Potter. [1897]. Size 11 × 7½, pp. 254. *Price 1s. Presented by the Hydrographic Office, Admiralty.*

Bibliography—English Catalogue. ———

The English Catalogue of Books for 1896. Giving full titles classified under Author and Subject in one strict alphabet, with particulars of the Size, Price, Month of Publication, and Name of Publisher of the Books issued in Great Britain and Ireland in 1896, and the principal books published in America. Being a continuation of the 'London' and 'British' Catalogues. London: Low & Co., 1897. Size 10½ × 6½, pp. 224. *Price 5s.*

Book of Reference—Statesman's Year-Book. **Keltie and Renwick.**

The Statesman's Year-Book. Statistical and Historical Annual of the States of the World for the Year 1897. Edited by J. Scott Keltie, with the assistance of I. P. A. Renwick, M.A., LL.B. London: Macmillan & Co., 1897. Size 7½ × 5, pp. xxxvi. and 1168. *Maps.* *Price 10s. 6d. Presented by the Publishers.*

The thirty-fourth annual publication of this invaluable compendium is appropriately provided with a series of double maps, showing the political divisions of Europe, Asia, Africa, North America, South America, Australasia, the British Empire, and Foreign Colonial possessions in 1837 and 1897 respectively. The usual comparative tables of the countries of the world, and the carefully revised statistics of each country and colony are, if possible, more complete than before.

NEW MAPS.

By J. Coles, *Map Curator*, R.G.S.

EUROPE.

Balkan Peninsula. **Kiepert.**

Generalkarte der Südost-Europäischen Halbinsel (Unter-Donau- und Balkan-Länder, Königreich Hellas und Creta). Bearbeitet von Heinrich Kiepert. Scale 1 : 1,500,000 or 23·7 stat. miles to an inch. Zweite berichtigte Ausgabe mit Eisenbahnnachträgen bis 1897. Berlin, 1897. Dietrich Reimer (Ernst Vohsen).

Crete. **Spratt.**

Die Insel Candia oder Creta. Reduction der vom Hydrographic Office in London, 1862; publicierten, 1852 durch Captn. Spratt &c. aufgenommen Karte im 2 Blatt. Scale 1 : 500,000 or 7·9 stat. miles to an inch. Geographische Velagshandlung Dietrich Reimer (Ernst Vohsen), Berlin.

At the present time these two maps will be useful for reference. On the latter, the place where the Greek troops landed, and the harbours guarded by the warships of the combined powers, are indicated. The administrative divisions are laid down, and some notes are given on the orthography.

England and Wales. **Ordnance Survey.**

Publications issued since March 8, 1897.

1-inch—General Maps:—

ENGLAND AND WALES:—256, 270, 271, revised, engraved in outline; 203, 222, 258, 268, 271, 314, revised, hills engraved in black or brown, 1*s.* each.

25-inch—Parish Maps:—

ENGLAND AND WALES:—**Durham** (revision), XIII. 11; XIV. 15; XXIV. 16; XXV. 12; XXVI. 5, 9; XXVII. 2, 3, 4, 5, 6, 7, 8, 9, 11; XXVIII. 1, 2, 3, 4, 5, 6, 7, 8; XXIX. 5, 3*s.* each. **Essex** (revision), XXXII. 11, 12; XXXIII. 1, 3, 5, 6, 7, 9, 10, 11, 12, 13, 15, 16; XXXIV. 1, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15; XXXV. 5; XLIII. 4, 9; XLIV. 13, 14, 15; XLV. 13; L. 5, 9; LI. 4, 8; LIII. 2, 5, 9; LIV. 5, 9, 10, 11; LVII. 2, 6; LVIII. 2; LIX. 4; LXI. 10; LXII. 13; LXX. 11; LXXIV. 6, 7, 11, 15; LXXV. 10, 14; LXXVI. 4, 5, 8, 9, 11, 13; LXXVII. 9, 12, 13; LXXXIII. 6; LXXXIV. 1, 3, 6, 7, 9, 10, 13, 3*s.* each. **Hampshire** (revision), XX. 12; XLVI. 13, 14; XLVIA. 16; XLVII. 4; XLVIII. 13, 15, 16; XLIX. 12, 16; LII. 14; LIV. 1, 2, 3, 5, 6, 7, 9, 10; LIVA. 4; LV. 5, 6, 10, 12, 13, 14, 15, 16; LVI. 15; LVIII. 14; LIX. 2; LX. 4, 8, 12; LXIV. 2; LXVI. 1, 11, 12, 14; LXVII. 2, 15, 16; LXVIII. 2, 5, 6, 7, 9, 10, 11, 3*s.* each. **Kent** (revision), XII. 4, 12, 13, 16; XV. 15 and 16; XVI. 9; XX. 2, 3, 4, 7, 8, 11, 12, 13, 15, 16; XXVII. 8; XXIX. 4; XXX. 16; XXXIX. 5, 9, 10; XL. 2, 16; L. 4, 7, 8, 12, 13, 16; LI. 5, 9, 11, 13, 15, 16; LII. 4, 8; LIX. 2; LX. 5, 6; LXI. 1, 2, 6, 10. **Middlesex** (revision), VIII. 1; XII. 14; XVII. 9; XXI. 7; XXIV. 15, 16; XXV. 6, 3*s.* each. **Northumberland** (revision), LX. 6, 10, 11, 12, 14; LXI. 9, 10, 11, 12, 13, 14; LXIII. 12; LXVIII. 2; LXX. 8; LXXI. 4, 12; LXXII. 2, 4, 5, 7, 9, 10, 11, 13, 14, 15, 16; LXXIII. 1, 2, 5, 9, 11 and 15, 13, 14; LXXIX. 3; LXXX. 1, 2, 3; LXXXI. 1, 2, 11, 12 and 16, 15; LXXXIX. 1, 2, 4, 5, 6, 9; CVIII. 12, 3*s.* each. **Surrey** (revision), V. 9; IX. 15–16; XIVA. 13; XX. 5, 6, 7, 9, 10, 13; XXI. 1, 9, 10; XXVIII. 10, 14; XXX. 11, 12; XXXII. 14; XXXIII. 12; XXXIV. 7, 8; XXXV. 5, 8, 11, 12; XXXIX. 13, 16; XL. 4, 12, 15 and XLVII. 3; XLI. 6, 12; XLII. 5, 10; XLIII. 9. **Sussex** (revised), II. 10, 12, 16; III. 6, 8, 9, 10, 13, 14, 15; IV. 6, 9; XII. 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; XXI. 8, 3*s.* each.

(*E. Stanford, Agent.*)

England and Wales. **Bartholomew.**

Bartholomew's Tourists' map of England and Wales. Scale 1 : 633,600 or 10 stat. miles to an inch. J. G. Bartholomew & Co., Edinburgh, 1897. 2 sheets. *Price 2s. each, mounted on cloth. Presented by the Publishers.*

These two maps include the whole of England and Wales, and Scotland south of Edinburgh, and the east coast of Ireland. As they have been prepared for the use of tourists and cyclists, special attention has been devoted to means of communication. All main roads are coloured brown, and the height above sea-level of some places are given.

England and Wales. **Bartholomew.**

Bartholomew's Reduced Ordnance Survey of England and Wales:—Cornwall and North Wales. Scale 1 : 126,720 or 2 stat. miles to an inch. By John Bartholomew, F.R.G.S. 1897. J. G. Bartholomew & Co., Edinburgh. *Price 2s. each, mounted on cloth. Presented by the Publishers.*

These two maps form part of the reduced ordnance survey series in course of publication by Bartholomew & Co. Roads suitable for cyclists and driving are distinguished from other roads by being coloured brown, with the elevations given at intervals. The map of Cornwall is orographically coloured, and in the map of North Wales the hills are shown by shading.

Germany. **Königl. Preuss, Landes-Aufnahme.**

Karte des Deutschen Reiches. Scale 1 : 100,000 or 1·6 stat. mile to an inch. Sheets: 354, Recklinghausen; 355, Dortmund. Herausgegeben von der Kartogr. Abtheilung der Königl. Preuss, Landes-Aufnahme, 1896. *Price* 1.50 *marks each sheet.*

Greece, Crete, etc. **Johnston.**

Maps of Greece, Crete, etc., to illustrate the Eastern Question. By Messrs. W. & A. K. Johnston. Edinburgh & London, 1897. *Price* 1*s. coloured. Presented by Messrs. W. & A. K. Johnston.*

This sheet contains seven maps and plans, which have been prepared with special

reference to the political situation in the East. The principal map is one of Greece, and includes the Turkish frontier. Maps of Turkey in Europe and Bulgaria and Crete are also given.

Norway. **Norges Geografiske Opmaaling.**

Topografisk Kart over kongeriget Norge. Scale 1 : 100,000 or 1·6 stat. mile to an inch. Sheets: B 26, D 6, H 17, I 16, I 17, I 18, K 17, K 18, U 3, Z 5, Æ 4, Ö 5, Ö 6. Norges Geografiske Opmaaling, Christiania. *Presented by the Norges Geografiske Opmaaling.*

Switzerland. **Schulthess.**

Maps and Plans illustrating the proposed Jungfrau Railway. 8 sheets and letterpress. Zurich: Friedrich Schultness, 1897.

This portfolio contains a series of maps, plans, and diagrams in connection with the proposed Jungfrau railway, which it is intended to carry to an altitude of 13,670 feet. In furtherance of this design the preliminary studies have been made, and are embodied in the letterpress which accompanies the maps and plans.

AFRICA.

German East Africa. **Kiepert and Moisel.**

Karte von Deutsch-Ostafrika. Scale 1 : 300,000 or 4·7 stat. miles to an inch. Sheets: D 5, Mpápwa; D 6, Dar-es-Salâm. Berlin: Geographische Verlagshandlung Dietrich Reimer (Ernst Vohsen).

These two sheets include the country lying between lat. 5° 30′ S. and 7° S. from the East Coast to long. 36° E. All the principal routes of travellers are shown, and the latest reliable material has been employed in their compilation.

AUSTRALIA.

South Australia. **Surveyor-General's Office, Adelaide.**

Plan of the Southern Portion of the Province of South Australia, 1896. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch.—Map of South Australia, showing Public Works under the Engineer-in-Chief's Department. To accompany Report of the Engineer-in-Chief, for the year ending June 30, 1896.—Plan showing Route traversed by the South Australian Stock Route Expedition from Oodnadatta, S.A., to Coolgardie, W.A., commanded by Mr. S. G. Hübbe, under authority of the Crown Lands Department, Adelaide, S.A., 1896. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch. 2 sheets.—Plan showing Route traversed by the South Australian Stock Route Expedition from Coolgardie to Eucla, W.A., commanded by Mr. S. G. Hübbe, under authority of the Crown Lands Department, Adelaide, S.A., 1896. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch.—Plan showing Pastoral Leases and Claims in the Northern Territory of South Australia. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch. 3 sheets. Surveyor-General's Office, Adelaide, S.A. *Presented by the Surveyor-General of South Australia.*

Western Australia. **Department of Lands and Surveys, Perth, W.A.**

Map of Western Australia, 1896. Scale 1 : 1,548,000 or 25 stat. miles to an inch. 4 sheets.—Map of Western Australia, 1896, showing electoral districts. Scale 1 : 1,584,000 or 25 stat. miles to an inch. 4 sheets.—Map of Western Australia, 1896. Scale 1 : 3,803,300 or 60·5 stat. miles to an inch. Department of Lands and Surveys, Perth, W.A. *Presented by the Department of Lands and Surveys, Perth, W.A.*

GENERAL.

Historical. **Poole.**

Historical Atlas of Modern Europe from the Decline of the Roman Empire; comprising also maps of parts of Asia and of the New World, connected with European History. Edited by Reginald Lane Poole, M.A., PH.D. Part vi. Oxford: the Clarendon Press. London, Edinburgh, and Glasgow: Henry Frowde. Edinburgh: W. & A. K. Johnston. 1897. *Price 3s. 6d. each part. Presented by the Clarendon Press.*

Part vi. of this atlas contains the following maps: No. xxvi. Scotland, showing the Ecclesiastical Divisions during the Middle Ages, with explanatory letterpress by G. Gregory Smith, M.A. No. xxxiii. The Frankish Dominions in Carolingian Times, with explanatory letterpress by Reginald Lane Poole, M.A., PH.D. No. lx. The Spanish Kingdoms, 1263–1492, by the late Ulick R. Burke, M.A.

School Atlas. **Melin.**

Atlas Melin. Historique et géographique spécialement établi pour les Cours de

l'Enseignement Secondaire. Nos. 2 and 3. André Paris, Editeur. À Moulins-sur-Allier.

The first part of this atlas was noticed in the *Geographical Journal*, December, 1895. Each of the two parts now issued, like the first, is divided into two sections. No. 2 contains, in the historical section, maps and notes on the history of France and Europe from the year 1270 to 1610, and in the geographical section, maps of Europe with a general description of the several states. In No. 3, the historical portion has reference to the history of Europe and France between the years 395 and 1270, and the geographical section contains maps of Africa, Asia, and Oceania.

This atlas has been specially prepared for educational purposes, and each map is accompanied by letterpress.

The World. **Vivien de Saint-Martin and Schrader.**

Atlas Universel de Géographie. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. France en 6 feuilles; feuille vi. Archipel Asiatique. Paris: Librarie Hachette et Cie.

These two sheets are the latest additions to the 'Atlas Universel,' which has been so many years in course of publication. Like all the other maps of this atlas which have been published, they are beautiful specimens of cartography.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty. January and February, 1897.

No.	Inches.	
2668	m = 2·9	Turkey in Asia:—Mersina roadstead. 1*s.* 6*d.*
422	m = 1·7	Newfoundland, west coast:—Port au Port. 2*s.* 6*d.*
2856	m = 3·63	Lake Erie:—Buffalo harbour and head of Niagara river. 1*s.* 6*d.*
468	m = 2·4	North America, east coast:—Fisher's island sound. 1*s.* 6*d.*
2859	m = 4·8	Plans on the south coast of San Domingo:—San Pedro de Macoris bay. 1*s.* 6*d.*
2197	m = 0·65	Ceylon, north coast:—Point Pedro to Delft island (plan, Kankasanturai anchorage). 2*s.* 6*d.*
1353	m = 0·15	Sumatra, north-east coast:—Diamond point to Pulo Berhala (plan, Deli river). 1*s.* 6*d.*
2732	m = {3·6 / 4·8}	Eastern archipelago:—Plans of anchorages in Bali, Lombok, Sumbawa, and adjacent islands.
2416	m = 0·35	Japan:—Liu Kiu islands (plan, Kerama channel and anchorages). 2*s.* 6*d.*
2265	m = 6·0	Japan:—Kobé and Hyogo bays. 1*s.* 6*d.*
470	m = 0·2	Eastern archipelago:—Aru islands. 1*s.* 6*d.*
382	m = 0·5	Fiji islands, north part:—Vanua Levu with Makongai and Koro. 2*s.* 6*d.*
474	m = 1·0	Tonga or Friendly islands:—Nomuka islands, Haapai group. 2*s.* 6*d.*
2317		Tana fiord to Varanger fiord:—New plan, Vadsö havn. Plan added, Bras havn.
2276		Bouin point to Sharopov point:—New plan.
1115		Yo chau fu to Kwei-chau-fu:—Plan added, Tungting lake.
982		Truk or Hogolu island:—Plan added, Losap islands.

(*J. D. Potter, agent.*)

Charts Cancelled.

No.		Cancelled by	No.
1663	Plan of Head harbour or Pic à Denis on this sheet.	New Chart. Port au Port	422
336	Plan of Buffalo harbour on this sheet.	New Chart. Buffalo harbour and head of Niagara river	2856
1353	Diamond point to North sands.	New Chart. Diamond point to Pulo Berhala	1353
1355	North sands to Singapoer.		
2416	Liu Kiu islands, southern portion.	New Chart. Liu Kiu islands	2416
2265	Kobé and Hiogo bays.	New Chart. Kobé and Hyogo bays	2265

Charts that have received Important Corrections.

Nos. A to P, Index chart (16 sheets). 2, British islands. 2268, England, south

coast:—Portland harbour. 2255, England, south coast:—Weymouth and Portland. 2484, England, east coast:—London to Gravesend. 2151, England, east coast:—River Thames, Broadness to Mucking light, etc. 1627, England, east coast:—Sunderland harbour. 2330, Norway:—Svenöer to Kosber islands, etc. 2751, Spitzbergen. 2360, Sweden:—Cape Falsterbö to Kalmar sound. 173, Baltic sea:—Approaches to Helsingfors and Sveaborg. 1770, Baltic sea:—Port of Libau. 867, Bermuda:—From the Narrows to Hamilton. 360, Bermuda islands. 2042, Cape Breton island:—Sydney harbour. 1651, Nova Scotia, Prince Edward island, and part of New Brunswick. 2666, North America, east coast:—St. John's to Halifax, etc. 2487, North America, east coast:—Portsmouth harbour. 2882, North America, east coast:—Gloucester harbour. 2427, North America, east coast:—Salem harbour, Marblehead and Beverley harbours. 2755, North America, east coast:—Long island sound, sheet 2, western part. 2479, North America, east coast:—Black rock and Bridgeport harbours. New Haven harbour. 2470, North America, east coast:—Connecticut river. 2806, North America, east coast:—Charleston harbour. 2861, North America, east coast:—St. Helena sound to Charleston harbour, etc. 268, North America, east coast:—Cape Fear to Sapelo sound. 523, Gulf of Mexico:—Port of Vera Cruz and anchorage of Anton Lizardo; Port of Vera Cruz; Alvarado harbour. 1638, Gulf of Mexico:—Breton sound to Dernière island, including delta of the Mississippi. 2881, Gulf of Mexico:—Key West harbour and approaches. 2897, Gulf of Mexico:—Tampa bay. 1324, South America, east coast:—Rio de la Plata to Rio Negro. 1300, Plans on the coast of Chile. 1340, Plans on the coast of Peru. 2531, United States, west coast:—Cape Mendocino to Vancouver island. 585, British Columbia:—Harbours in the strait of Georgia. 584, British Columbia:—Sydney inlet to Nitiuat, etc. 1862, Africa, west coast:—Lekki to river Dodo. 681, Africa, east coast:—Lindi river; Mgau Mwania. 40, India, west coast:—Karáchi harbour. 655, India, west coast:—Port of Bombay. 2621, India, west coast:—Bombay harbour. 2284, Plans of anchorages on the west coast of Sumatra. 219, Sumatra, west coast:—Acheh head to Diamond point. 2510, Cocos or Keeling islands. 1965, Tong-King gulf:—Kua Lacht to Kao Tao shan islands, etc. 1262, China:—Hongkong to gulf of Liau tung. 2920, Australia, east coast:—Cape Direction to Cape Grenville. 2766, North-east coast of New Guinea, with Bongainville, New Britain, New Ireland, Admiralty islands, and off-lying reefs. 1469, Solomon islands:—Guadalcanar and Florida islands, etc. 769, Pacific ocean:—Admiralty and Hermit islands. 905, Fiji islands:—Suva harbour to Levuka. 1249, Fiji islands:—Ovalau and Moturiki islands. 765, Pacific ocean:—Tokelau (Union group).

(*J. D. Potter, Agent.*)

Norwegian Charts. **Norges geografiske Opmaaling.**

Specialkart over den Norske Kyst fra Ny Hellesund til Lindesnes.—Specialkart over den Norske Kyst fra Lindesnes til Lister.—Specialkart over den Norske Kyst fra Lister til Rægefjord og Nesvaag.—Specialkart over den Norske Kyst fra Nesvaag til Ogne.—Specialkart over den Norske Kyst fra Gjæslingerne til Dolmsund. Scale 1: 50,000 or 0·8 stat. mile to an inch. Norges Geografiske Opmaaling. Christiania. *Presented by the Norges Geografiske Opmaaling.*

United States Charts. **U.S. Hydrographic Office.**

Pilot Charts of the North Atlantic and North Pacific Oceans for March, 1897. Published at the Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

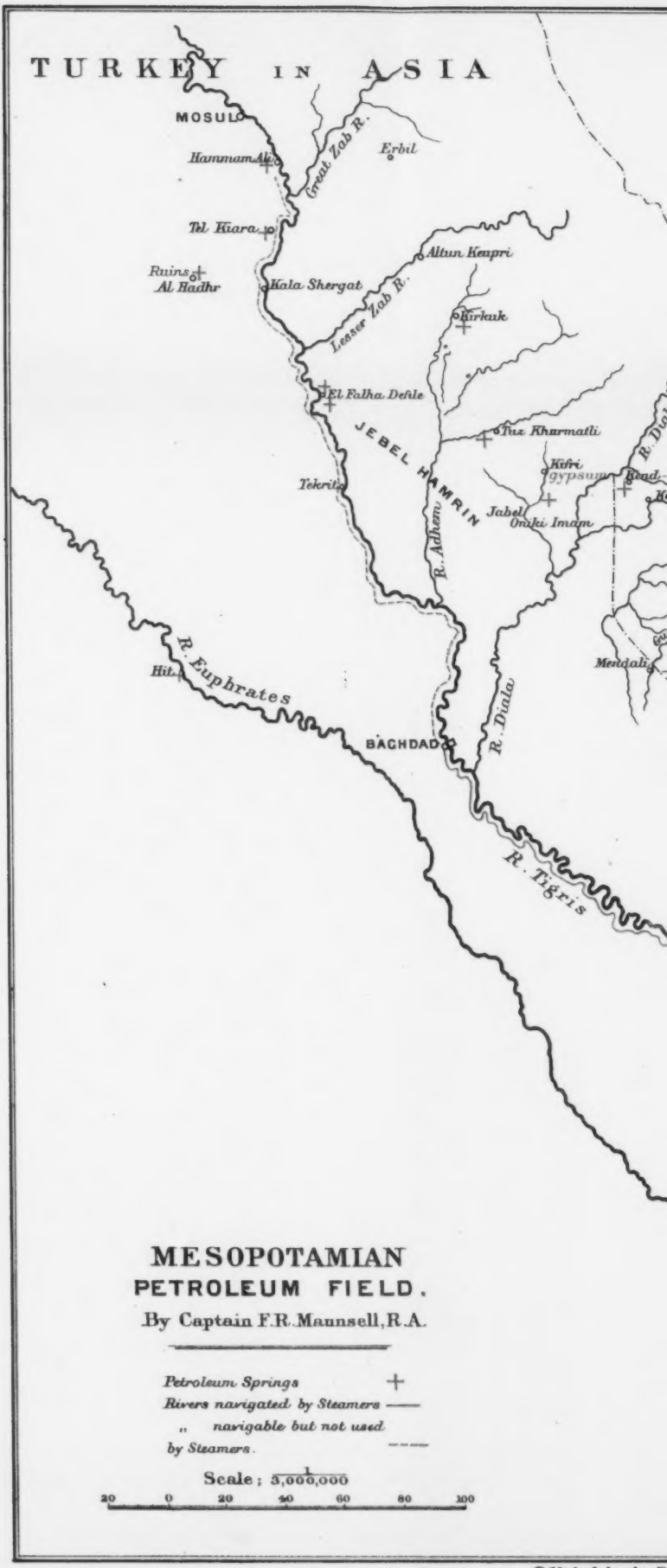
PHOTOGRAPHS.

Afghan-Baluchistan Boundary. **Tate**

Sixteen Photographs of the country in the neighbourhood of the Afghan-Baluchistan boundary, taken during the expedition of the Boundary Commission, 1896, by G. P. Tate, Esq. *Presented by G. P. Tate, Esq.*

This is an interesting series of photographs taken by Mr. G. P. Tate, Government Surveyor, on the borders of Afghanistan and Baluchistan. They convey an excellent idea of the scenery, buildings, and antiquities of the country.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.



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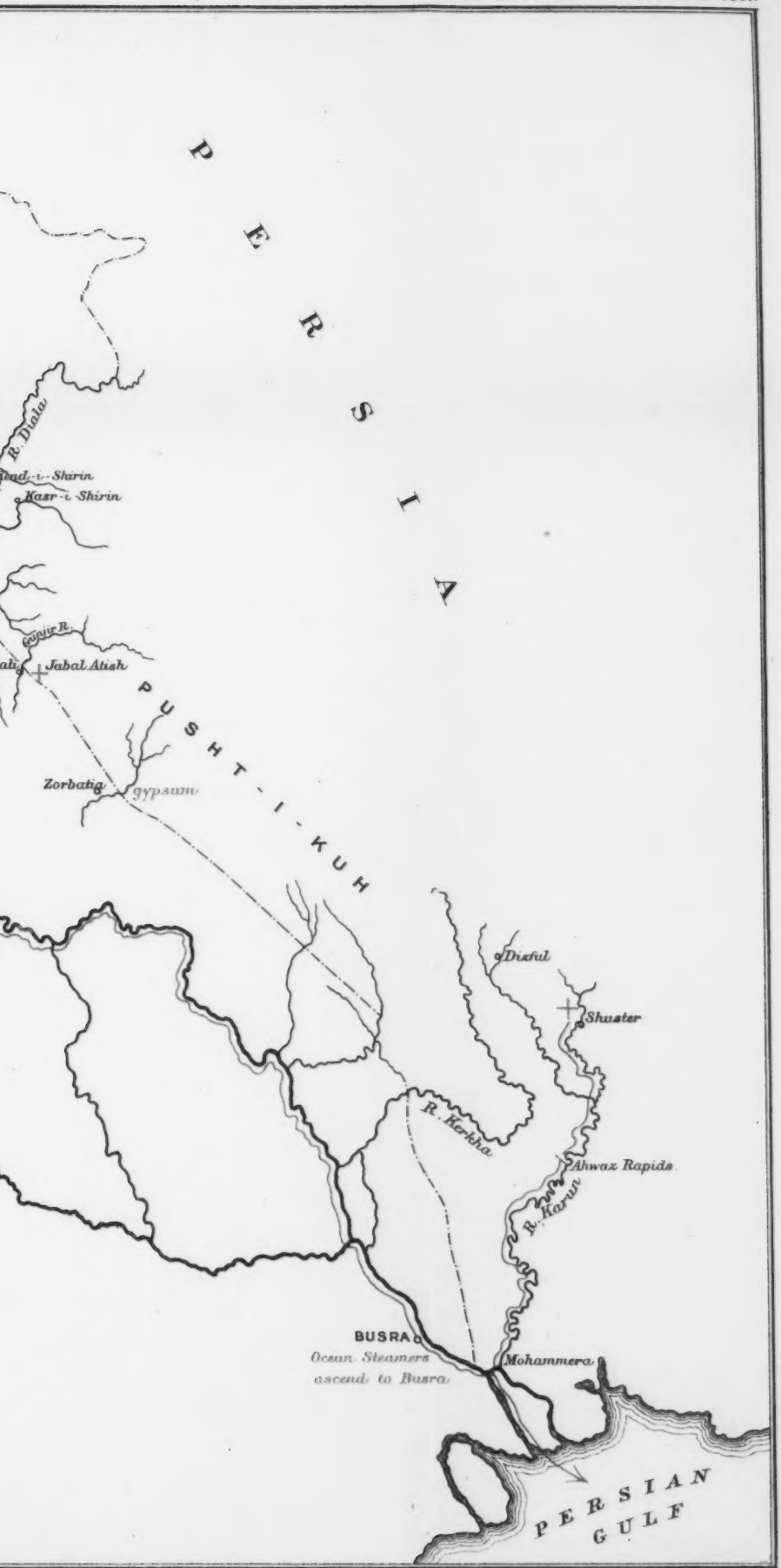

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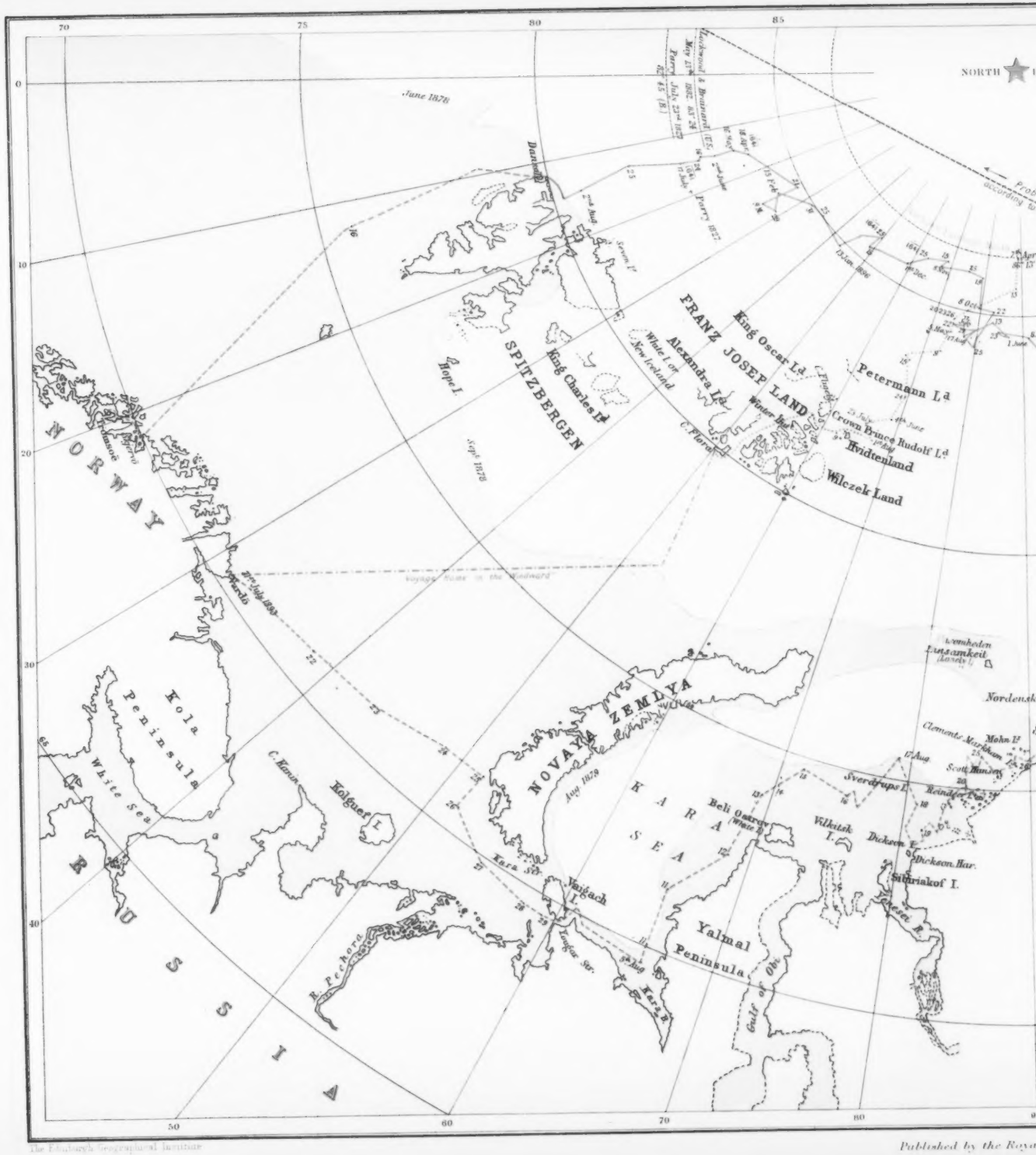
F.S.Weller, F.R.G.S.



The Edinburgh Geographical Institute

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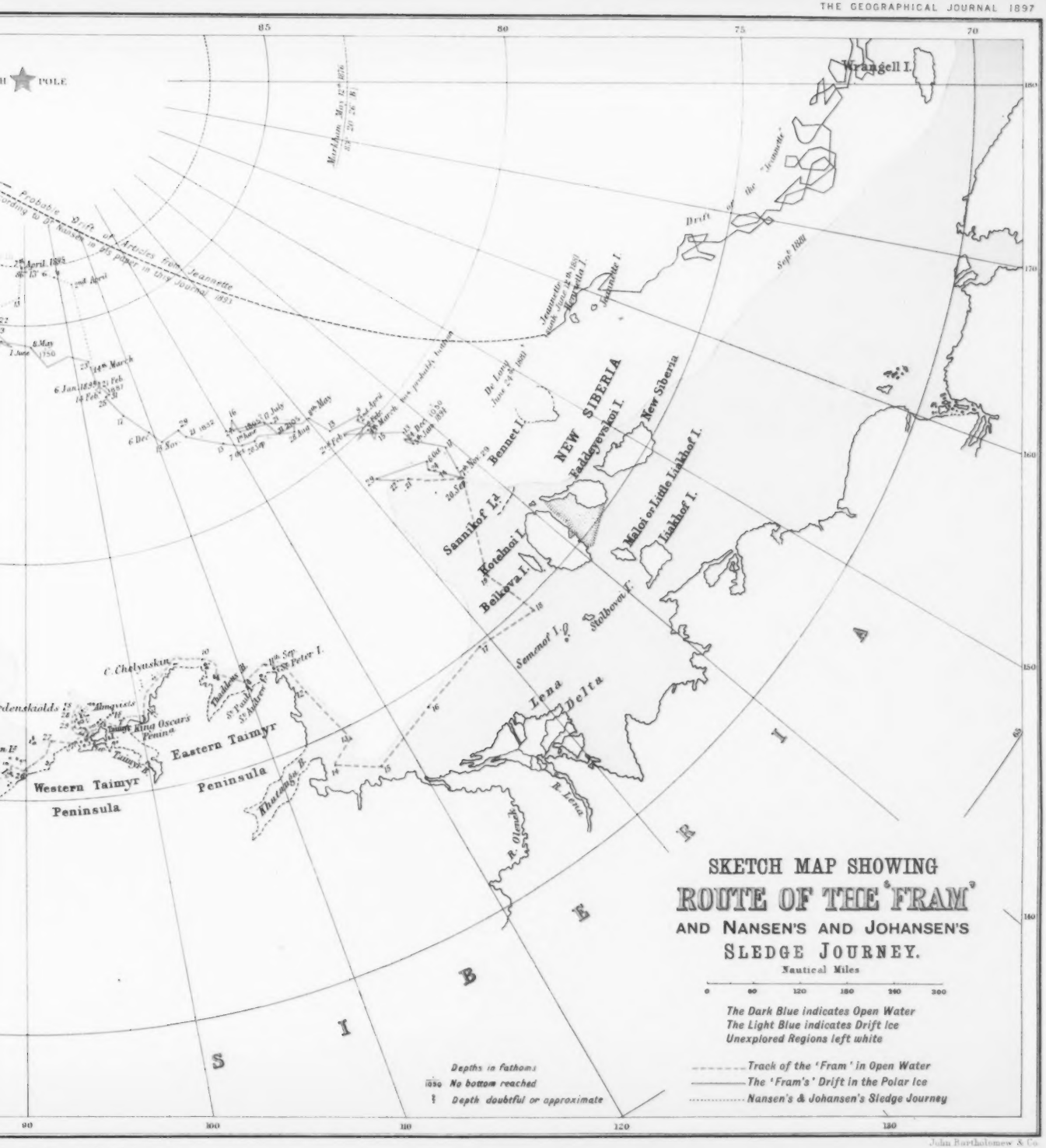

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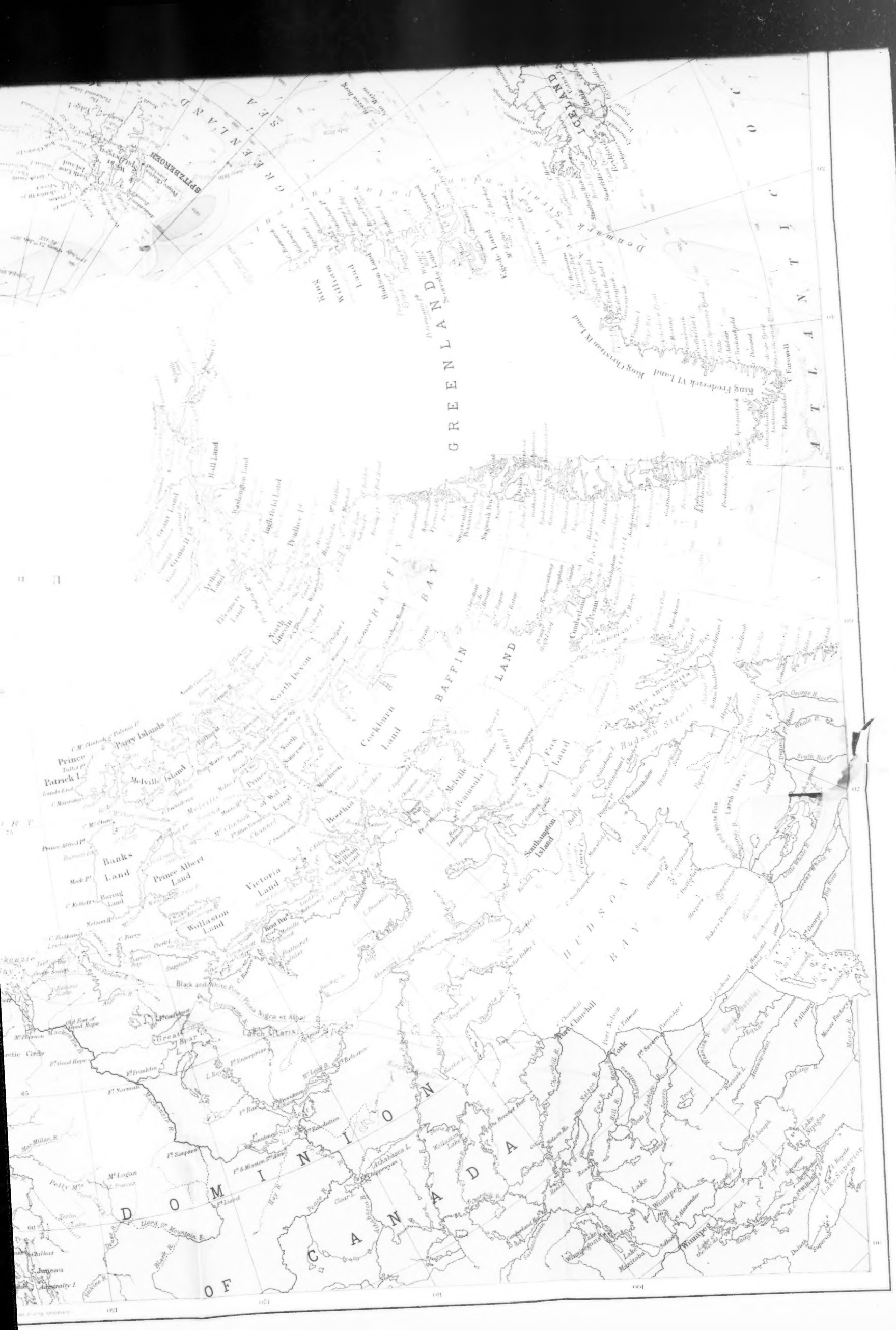
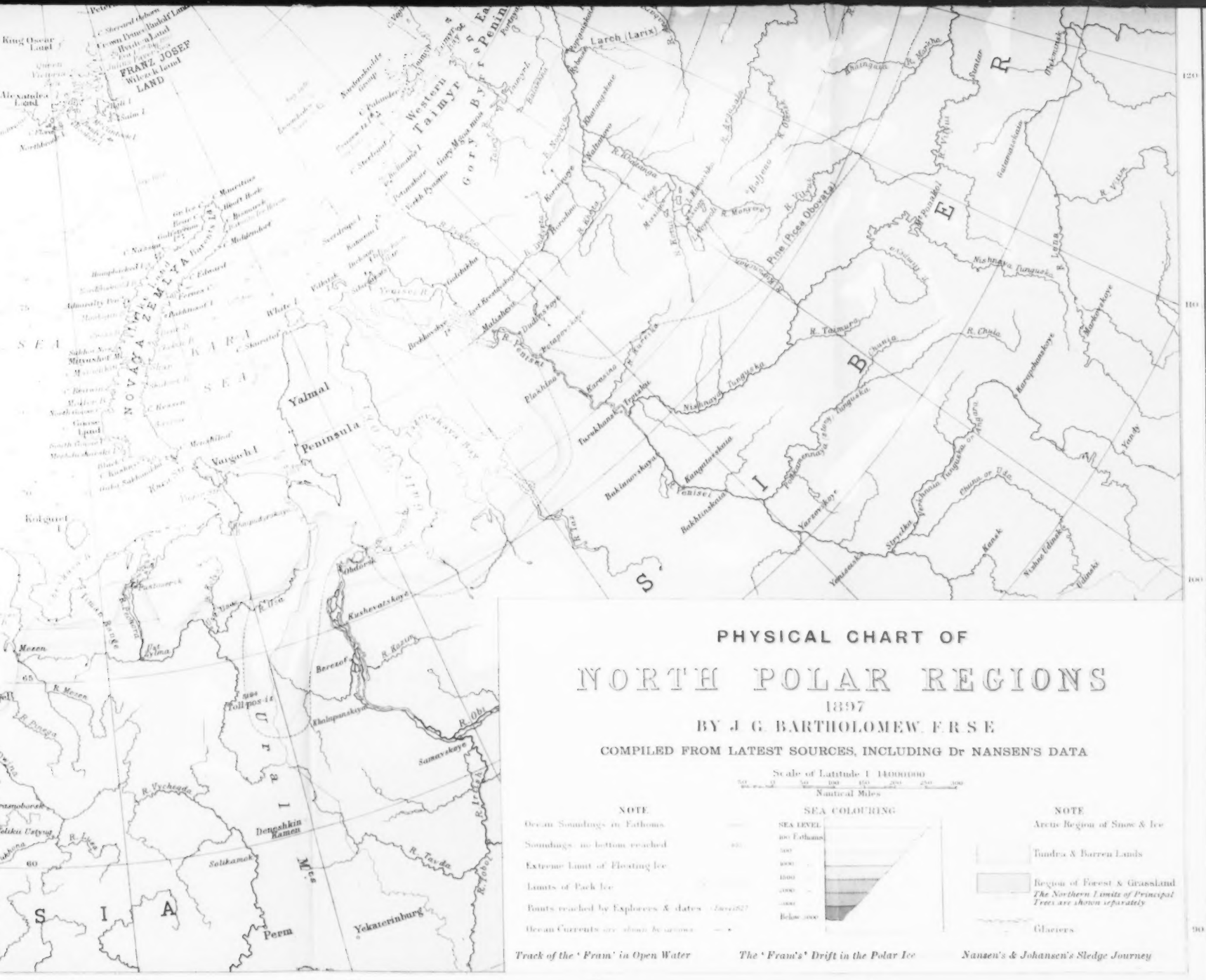
John Bartholomew & Co.


GREENLAND
DOMINION OF CANADA
ATLANTIC OCEAN
BAFFIN BAY
HUDSON BAY
DAVIS STRAIT
Hudson Strait
Denmark Strait
GREENLAND SEA
ICELAND
SPITZBERGEN
King Frederick VI Land
King Christian IX Land
Hall Land
Grant Land
Greenland
Ellesmere Land
Arthur Land
North Lincoln
North Devon
Parry Islands
Prince Patrick I.
Melville Island
Banks Land
Prince Albert Land
Victoria Land
Wollaston Land
Baring Land
Boothia
King William Land
Cockburn Land
Melville Peninsula
Fox Land
Southampton Island
Black and White Pine (Pinea Nigra et Alba)
Larch (Larix)
Great Bear L.
Great Slave L.
Athabasca L.
Lake Winnipeg
Lake Manitoba
Lake Superior
Lake Nipigon
Meta incognita
Cumberland Sd.
Frobisher B.
Resolution I.
Kingmiut
Nugsuak Pen.
Disko
Upernivik
Proven
Godthaab
Julianehaab
Frederikshaab
Godhavn
Holsteinborg
Sukkertoppen
Fredericksdal
Frederikshaab
Jacobshavn
Ivigtut
Tasiusak
Tunugdliarfik
Prince of Wales Sd.
Lancaster Sd.
Barrow Str.
Wellington Chan.
Jones Sd.
Smith Sd.
Kane Basin
Kennedy Chan.
Robeson Chan.
Hell Gate
Melville B.
Wellington Channel
Queen Victoria Str.
Franklin B.
Parry Bay
Dease R.
Simpson R.
Mackenzie R.
Peel R.
Liard or Mountain R.
Hay R.
Peace R.
Athabasca R.
Slave R.
Nelson R.
Hill R.
Severn R.
Albany R.
Moose R.
Abitibi R.
Winnipeg R.
Red R.
Assiniboine R.
Saskatchewan R.
Churchill R.
Great Fish R.
Back R.
Coppermine R.
Kent Bar
Melville I.
Bathurst Inlet
Perry R.
Clarence R.
Yukon R.
Porcupine R.
Stikine R.
Chilkat
Juneau
Admiralty I.
Queen Charlotte Is.
Vancouver I.
Prince Rupert
Victoria
Nanaimo
Fort Simpson
Fort Liard
Fort Norman
Fort Good Hope
Fort Rae
Fort Providence
Fort Resolution
Fort Enterprise
Fort Reliance
Fort Confidence
Fort Franklin
Fort Macpherson
Fort Churchill
Fort Nelson
Fort Severn
Fort York
Fort Albany
Fort Rupert
Fort Simpson
Fort Halkett
Fort Liard
Fort Nelson
Fort Vermilion
Fort Dunvegan
Fort Assiniboine
Fort Edmonton
Fort Pitt
Fort Carlton
Fort Qu'Appelle
Fort Ellice
Fort Pelly
Fort Alexander
Fort William
Fort Frances
Fort Wrangell
Fort Simpson
Fort Rupert
Fort Victoria
Fort Langley
Fort Hope
Fort Kamloops
Fort Alexandria
Fort George
Fort Chipewyan
Fort Resolution
Fort Providence
Fort Rae

R U S S I A
Yakutsk
R. Lena
R. Aldan
Verkhoyansk Mts
Kekh-tas Mts
Kolymskiya Mts
Okhotsk
Okhotsk Sea
KAMCHATKA
Mountains
Mt Kamen
Mt Klutchi
Mt Ushkovsk
Penshinskaia Bay
Gulf of Anadir
Anadir R.
Anadir Bay
Behring Sea
Behring I.
Commanders Is
Medni I.
Near Is
Attu I.
C. Wrangell
ALEUTIAN ISLANDS
Rat Islands
Andreanof Is
Fox Islands
Four Mountains
Alaska Peninsula
Kadiak I
PACIFIC OCEAN
BERING SEA
Wrangell I.
Herald I.
Plover Bay
Western Tajmyr
Peninsula
Eastern Tajmyr
Taimyr L.
Severnaya Zemlya
Nordenskiold Land
Bennett Island
De Long Islands
Liakhof Is or New Siberia
Kotelnoi I.
Great Liakhof I.
Novaya Sibir or New Siberia
Sannikof Land
Jeannette I.
Henrietta I.
Kotelnoi Strait
Stolbovoi I.
Faddeyevski I.
Semenovski I.
Bolshoi Lyakhovski I.
Maloi Lyakhovski I.
Kotelnoi Island
Sannikof Strait
Yana R.
Indigirka R.
Kolyma R.
Omolonski
Polousni Mts
Anadirski Mts
Tomus khaia Mts
Yukon Hills
Kojuk Mts
Yukon R.
Tanana Hills
Shamana Mt.
Nuklukayeto
Arctic City
Circle City
Fort Yukon
Fort Hamlin
Fort Selkirk
Fort Reliance
Fort Mc Pherson
Fort Macleod
Fort Norman
Fort Simpson
Fort Good Hope
Fort Rae
Fort Resolution
Fort Chipewyan
Fort Providence
Fort Smith
Fort Liard
Fort Nelson
Fort Halkett
Fort Mc Murray
Fort Vermilion
Fort Dunvegan
Fort Saint John
Fort Grahame
Fort Mc Leod
Fort Chipman
Fort Selkirk
Fort Yukon
Fort Reliance
Fort Mc Pherson
Fort Macleod
Fort Norman
Fort Simpson
Fort Good Hope
Fort Rae
Fort Resolution
Fort Chipewyan
Fort Providence
Fort Smith
Fort Liard
Fort Nelson
Fort Halkett
Fort Mc Murray
Fort Vermilion
Fort Dunvegan
Fort Saint John
Fort Grahame
Fort Mc Leod
Fort Chipman
Mackenzie R.
Mackenzie Bay
Beaufort Sea
Franz Josef Land
Alexandra Land
Hooker Island
Wilczek Land
Mt Wrangell
Mt St Elias
Mt Logan
Mt Fairweather
Mt Crillon
Chichagof I.
Prince William Sd
Kenai Pen
Kadiak I
Shumagin Is
Unalaska I
Sitkinak I
Tanaga I
Kanaga I
Adakh I
Amchitka I
Kiska I
Attu I
Semichi Is
Near Is
Rat Islands
Andreanof Is
Fox Islands
Four Mountains
Alaska Peninsula

ATLANTIC OCEAN
ICELAND
GREENLAND SEA
SPITZBERGEN
BARENTS S
Arctic Circle
BRITISH ISLES
IRELAND
Dublin
Cork
SCOTLAND
Glasgow
Edinburgh
Aberdeen
Belfast
WALES
ENGLAND
Liverpool
Manchester
Birmingham
LONDON
NORTH SEA
ENGLISH CHANNEL
NORWAY
Trondhjem
Bergen
CHRISTIANIA
Drontheim
Lapland
Finmarken
Kola Peninsula
Finland
Uleaborg
Archangel
SWEDEN
STOCKHOLM
Upsala
Gothenburg
Helsingfors
Wiborg
Lake Ladoga
Gulf of Finland
BALTIC SEA
DENMARK
COPENHAGEN
Reval
ST PETERSBURG
Novgorod
RUSSIA
Riga
NETHERLANDS
Amsterdam
The Hague
Rotterdam
Antwerp
BELGIUM
Ostend
Calais
Boulogne
Le Havre
Rouen
PARIS
FRANCE
Orleans
Dijon
Nancy
GERMAN EMPIRE
Bremen
Hamburg
Stettin
BERLIN
Danzig
Frankfurt
Cologne
Konigsberg
Dunkirk
Amiens
Caen
Cherbourg
Guernsey
Jersey
Portland
Plymouth
Falmouth
Penzance
Land's End
Scilly Is
Holyhead
Liverpool
Manchester
Leeds
York
Hull
Lincoln
Norwich
Yarmouth
Harwich
Ipswich
Colchester
Sheerness
Dover
Brighton
Portsmouth
Southampton
Exeter
Torquay
Weymouth
Bristol
Gloucester
Worcester
Shrewsbury
Chester
Carlisle
Newcastle
Durham
Berwick
Aberdeen
Dundee
Perth
Stirling
Greenock
Ayr
Belfast
Londonderry
Galway
Limerick
Waterford
Wexford
Kilkenny
Dublin
Cork
Shetland Is
Orkney Is
Hebrides
Faroe Is
Iceland
Stockholm
Upsala
Gothenburg
Helsingborg
Malmo
Carlscrona
Calmar
Westervik
Oxelosund
Nykoping
Orebro
Karlstad
Wenersborg
Gefle
Sundsvall
Hernosand
Ostersund
Umea
Lulea
Tornea
Haparanda
Kajana
Uleaborg
Brahestad
Kemi
Tornea
Kengis
Kola
Kandalaksha
Umba
Sosnovetz
Archangel
Onega
Lake Onega
Lake Ladoga
Wiborg
Helsingfors
Abo
Tavastehus
Nystadt
Frederikshamn
Fredrikstad
Christiansand
Stavanger
Haugesund
Bergen
Trondhjem
Drontheim
Namsos
Rorvik
Mosjoen
Bodo
Hammerfest
Vardo
Tromsoe
Alten
Kautokeino
Karasjok
Vadsoe
Varanger Fiord
North Cape
Nordkyn
Lofoten Is
Vesteraal Is
Tromsoe
Hammerfest
Vardo



PHYSICAL CHART OF
NORTH POLAR REGIONS
1897

BY J. G. BARTHOLOMEW, F.R.S.E.

COMPILED FROM LATEST SOURCES, INCLUDING Dr NANSEN'S DATA

Scale of Latitude 1 : 14000000

Nautical Miles

NOTE

Ocean Soundings in Fathoms

Soundings: no bottom reached

Extreme Limit of Floating Ice

Limits of Pack Ice

Routs reached by Explorers & dates

Ocean Currents

SEA COLOURING

SEA LEVEL

100 Fathoms

500

1000

2000

3000

Below 3000

NOTE

Arctic Region of Snow & Ice

Tundras & Barren Lands

Region of Forest & Grassland

The Northern Limits of Principal Trees are shown separately

Glaciers

Track of the 'Fram' in Open Water

The 'Fram's' Drift in the Polar Ice

Nansen's & Johansen's Sledge Journey

Royal Geographical Society

John Bartholomew & C°